Time for a Change

The Effects of Subgroup Dynamics and Time on Psychological Safety

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Summary (English)

Psychological safety is a key factor for successful teamwork. Psychological safety signifies that individuals who work together share the belief that their team is safe for interpersonal risk taking. Since the 1970s, researchers have emphasized the importance of psychological safety for work teams in order to deal with changes and related feelings of uncertainty due to a competition-oriented and fast-paced labor market. Numerous studies demonstrated the relevance of psychological safety for learning from failures and for the improvement of performance levels in all kinds of work contexts. Most notably, psychological safety was found to be related to patient safety in clinical contexts. Thus, psychological safety is particularly relevant in team settings where customers or patients depend on the team's performance, as is the case in hospital teams, care teams, flight crews, and other interdisciplinary team settings.

Changes are inherent in the nature of psychological safety. Yet, researchers have just begun to investigate how psychological safety forms and develops over time. First findings on the development are inconsistent and previous research lacks an overall theoretical framework on the effects of time and other group-bounded factors that affect the development of psychological safety.

This dissertation contributes to previous research by focusing on dynamics of psychological safety and embedding the hypotheses into a more holistic theoretical framework on team development over time. More precisely, this work builds on the model of group faultlines that considers group diversity, and more specifically subgroup emergence, as one important origin of psychological safety dynamic across teams. Accordingly, team faultlines, defined as hypothetical lines that split a team into subgroups based on multiple attributes, have a negative impact on the formation of psychological safety. Furthermore, this work refers to a theoretical approach, which emphasizes the inclusion of time in team research thereby encouraging researchers to take a more dynamic perspective on team processes by studying the changes and subsequent effects on team outcomes. As teams are sensitive to signals of psychological safety from the very beginning of teamwork, this work focused on the relation between trajectories of team psychological safety change and team performance.

In Study 1, I referred to the Leader-Member-Exchange theory and examined differences in team members' perceptions caused by subgroup dynamics. Accordingly, members who belong to the in-group of the leader benefit from more exchange of resources compared to members of an out-group. I tested the relation of subgroup belonging and psychological safety in the presence of high or low task conflict, as conflicts are critical events that impact psychological safety. I found that team members who were close to the leader in terms of demographic similarity were less affected by high task conflict compared to members who were demographically different from the leader. This study thus identified a boundary condition of psychological safety, namely subgroup belonging, as being similar to the leader buffered the negative effects of task conflict on perceptions of interpersonal risk-taking.

Regarding the development of team perceptions of psychological safety, first studies indicated that psychological safety either remains relatively stable, or slightly decreases over time. In Study 2, I therefore focused on the development of psychological safety and antecedents of both the formation and changes over time. I tested for the effects of three well-studied deep level diversity attributes, namely values, team ability, and team personality, and for effects of group faultlines on psychological safety. The results showed that psychological safety decreased over time. Furthermore, teams who had a strong attitude toward teamwork and were characterized by a weak faultline started into the project with high initial levels of psychological safety (as compared to teams with low attitude toward teamwork and strong faultlines). Yet, in teams with high task-specific skills, psychological safety decreased (as compared to teams with low skills), whereas in teams with high team conscientiousness, psychological safety increased over time (as compared to teams with low team conscientiousness). This study demonstrated the relevance of considering temporal dynamics of psychological safety in team research. Further studies should investigate which factors, other than time, predict the negative development. Does it reflect a natural phenomenon in teams, or are there other mechanisms that explain this finding more accurately such as cross-subgroup communication? Furthermore, important conditions for the formation and development of psychological safety were identified that could provide starting points for the design of interventions regarding how and when the development of psychological safety should be supported from leaders or team coaches.

As a consequence of the previous results, the focus of the third study was put on team trajectories of psychological safety, more precisely, whether changes of psychological safety affected team variables such as team performance. According to team development theories, the first half of a project is decisive as team members lay the foundation for important changes around midpoint. A constructive discussion and evaluation at midpoint again separated high- from low-performing teams. Thus, besides absolute levels, relative changes should affect team performance. The results support this proposition as changes of psychological safety predicted team effectiveness above and beyond absolute levels. Taken together, this work highlights the effects of subgroup dynamics and time for research on psychological safety. This dissertation is a pioneer work as all three studies provide crucial insights on dynamics of psychological safety opening up implications for practitioners and new avenues for future research.

Summary (German)

Psychologische Sicherheit ist ein Schlüsselfaktor für erfolgreiche Teamarbeit. Psychologische Sicherheit bedeutet, dass Personen, die zusammenarbeiten, den Glauben teilen, dass das Team sicher ist, um interpersonelle Risiken einzugehen. Seit Mitte der 70er Jahre betonen Forscher die Bedeutung von psychologischer Sicherheit für Arbeitsteams und deren Umgang mit den Veränderungen und der damit verbundenen Unsicherheit verursacht durch einen wettbewerbsorientierten und schnelllebigen Arbeitsmarkt.

Zahlreiche Studien zeigen die Relevanz von psychologischer Sicherheit für das Lernen aus Misserfolgen und die Verbesserung der Teamleistung in verschiedenen Arbeitskontexten auf. Ein Befund zeigt, dass psychologische Sicherheit mit der physiologischen Sicherheit von Patienten assoziiert ist. Folglich ist psychologische Sicherheit insbesondere dann von Bedeutung, wenn Patienten oder Klienten von der Leistung eines Teams abhängig sind, wie das bspw. in OP-Teams, Pflegeteams, Flugbesatzung, oder anderen interdisziplinären Settings der Fall ist.

Obgleich psychologische Sicherheit auf Gruppenebene konzeptualisiert ist und Veränderungen in der Natur dieses Konstruktes liegen, haben Forscher erst vor Kurzem begonnen zu untersuchen, wie psychologische Sicherheit entsteht und sich im Verlauf der Zusammenarbeit verändert.

Jedoch sind die Befunde inkonsistent und der Forschung fehlt ein konzeptuelles Rahmenmodell darüber, wie die Zeit und andere durch die Gruppe bedingte Faktoren die Entwicklung von psychologischer Sicherheit beeinflussen.

Diese Dissertation trägt zur vorherigen Forschung bei, indem sie den Fokus auf die Dynamiken psychologischer Sicherheit legt und die Forschungsthesen in ein ganzheitliches theoretisches Rahmenmodell zur Entwicklung von Teams einbettet.

Im Einzelnen stützt sich die Arbeit auf das Modell der Gruppenbruchlinien, das Gruppendiversität als eine wichtige Ursache für dynamische Prozesse in Teams aufgrund von Subgruppenbildung ansieht. Demnach haben Gruppenbruchlinien (Faultlines), sogenannte hypothetische Linien, die Teams in homogene Subgruppen anhand multipler Attribute teilen, negative Folgen auf die Entstehung von psychologischer Sicherheit.

Weiterhin bezieht sich die Arbeit auf einen theoretischen Ansatz, der den Einbezug der Zeit in den Vordergrund rückt und Forscher ermutigen soll eine dynamischere Perspektive auf Teamprozesse einzunehmen und Veränderungen sowie deren Folgen für Teamarbeit zu studieren. Da Teams von Beginn an und in den frühen Phasen der Zusammenarbeit für Signale psychologischer Sicherheit empfänglich sind, lag der Fokus auf Veränderungen in der psychologischen Sicherheit und dem Zusammenhang zwischen Veränderungen und Teamleistung.

In Studie 1 bezog ich mich auf die Leader-Member-Exchange Theorie und untersuchte Unterschiede in der Wahrnehmung von psychologischer Sicherheit von Teammitgliedern aufgrund von Subgruppendynamik. Demnach profitieren In-Group Mitglieder der Führungskraft von einem höheren

Austausch von Ressourcen im Vergleich zu Mitgliedern der Out-Group. Ich testete die Beziehung von Subgruppenzugehörigkeit und psychologischer Sicherheit in der Präsenz von hohem vs. niedrigem Aufgabenkonflikt, da Konflikte kritische Ereignisse sind, die sich negativ auf die psychologische Sicherheit auswirken können. Ich fand heraus, dass Teammitglieder, die mit ihrer Führungskraft demographisch ähnlich waren, von den negativen Auswirkungen von Aufgabenkonflikt weniger betroffen waren als Teammitglieder, die sich von der Führungskraft diesbezüglich unterschieden. Diese Studie identifiziert eine Grenzbedingung für psychologische Sicherheit, nämlich die Subgruppenzugehörigkeit, da die demographische Nähe zur Führungskraft den negativen Effekt von Aufgabenkonflikt für die Wahrnehmung von psychologischer Sicherheit pufferte.

Hinsichtlich der Entwicklung von psychologischer Sicherheit, legen erste Studien nahe, dass sie sich nicht verändert, bzw. Über die Zeit leicht abnimmt. In Studie 2 untersuchte ich daher die Entwicklung von psychologischer Sicherheit und Antezedenzien für die Entstehung und Veränderungen im Verlauf der Zeit. Ich testete für Effekte von drei gut erforschten tieferliegenden Diversitätsattributen, nämlich Werte, Teamfähigkeit und Teampersönlichkeit. Die Ergebnisse zeigen, dass psychologischer Sicherheit über die Zeit abnahm. Darüber hinaus starteten Teams, die eine positive Einstellung zu Teamarbeit hatten und deren Gruppe von schwachen Faultlines gekennzeichnet war, mit einem hohen Anfangsniveau an psychologischer Sicherheit in die Projektarbeit (im Vergleich zu Teams mit negativer Einstellung zur Teamarbeit und starker Faultline). Allerdings nahm die psychologische Sicherheit in Teams mit hohen aufgabenspezifischen Fähigkeiten (im Vergleich zu niedrigen aufgabenspezifischen Fähigkeiten) über die Zeit ab, wohingegen sie in Gruppen mit hoher Gewissenhaftigkeit (im Vergleich zu niedriger Gewissenhaftigkeit) zunahm. Die Studie zeigt die Relevanz der Berücksichtigung von zeitlichen Dynamiken der psychologischen Sicherheit in der Team Forschung. So kann weiterführend dazu geforscht werden, welche anderen Faktoren als Zeit die negative Entwicklung vorhersagen. Handelt es sich hierbei um eine natürliche Entwicklung in Teams, oder erklären andere Mechanismen wie bspw. Kommunikation über Subgruppen hinweg diesen Befund? Darüber hinaus wurden wichtige Konditionen für die Entstehung und Entwicklung von psychologischer Sicherheit identifiziert, die zur Planung von Inhalten und dem Timing von Teaminterventionen zur Förderung der psychologischen Sicherheit durch Führungskräfte oder Team Coaches genutzt werden können.

Als Konsequenz der vorherigen Ergebnisse, lag der Fokus der dritten Studie auf den Teamverläufen von psychologischer Sicherheit, präziser noch, auf den Effekten von Veränderungen psychologischer Sicherheit und deren Auswirkungen auf andere Teamvariablen wie bspw. Teamleistung. Laut Team Entwicklungstheorien ist die erste Hälfte der Projektarbeit entscheidend da Teammitglieder die Fundamente für bedeutende Veränderungen zur Mitte legen. Eine konstruktive Diskussion und Bewertung zur Mitte des Projektes wiederum trennt Hochleistungsteams von Teams mit schwacher Leistung. Daher sollte neben der absoluten Einschätzung von psychologischer Sicherheit auch die relative Veränderung Auswirkungen auf die Teamleistung haben. Die Ergebnisse unterstützen diese

Annahme. Wir fanden dass Veränderungen in der psychologischen Sicherheit die Teameffektivität über die Baseline hinaus vorhersagten.

Insgesamt hebt diese Arbeit die Effekte von Subgruppendynamiken und Zeit für die Forschung von psychologischer Sicherheit hervor. Diese Dissertation leistete Pionierarbeit indem alle drei Studien entscheidende Einsichten in die Dynamiken von psychologischer Sicherheit bieten und Implikationen für Praktiker beinhalten sowie neue Bereiche für zukünftige Forschung eröffnen.

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1 Psychological Safety in Teams and Organizations

1.1 Relevance of the Topic

Psychological safety is the key factor that enables teams to keep pace in changing times. Psychological safety means that individuals who work together share the belief that their team is safe for interpersonal risk taking. More precisely, members of teams with high levels of psychological safety dare putting up difficult issues, mistakes, or flaws for discussion because team members rely on the fact that this can be done without losing face. Consequently, teams benefit from confrontations and task conflict in order to prevent future mistakes, which might have detrimental effects for individuals, teams, or the environment (Edmondson, 1999, 2002).

The concept of psychological safety has found its way into the organizational context a long time ago. It was first mentioned in 1965 by two psychological climate researchers, namely Edgar H. Schein and Warren G. Bennis in their work on *Personal and organizational change through group methods*. They emphasized that today's working world is subject to the impact of time and changes in regards to the workforce, working environments, job specifications, and work demands embedded in a fast-paced labor market. In such times, it is most important to keep pace with the changes ahead. Kahn picked the concept of psychological safety up again in 1990, and recently it experienced a renaissance in organizational psychology (Edmondson & Lei, 2014).

Psychological safety is a crucial factor for organizations' competitiveness and survival as it has been identified as the most powerful characteristic of high-performing teams (Bergmann & Schaeppi, 2016; Newman, Donoghue, & Eva, 2017). Furthermore, in teams with high levels of psychological safety, members report more errors enabling learning processes from failures (Edmondson, 1996), and more importantly, these members feel welcome to address potential problems directly, preventing mistakes from happening in the first place. Research gives evidence, that psychological safety is important in numerous setting, such as the medical setting (e.g., Edmondson, 1996), health care settings (Nembhard & Edmondson, 2006), educational setting (Van den Bossche, Gijselaers, Segers, & Kirschner, 2006), innovative setting (e.g., innovation teams, Baer & Frese, 2003; Edmondson & Mogelof, 2005), or psychotherapy (Rappoport, 1997). Further, among other for organizations relevant outcomes, psychological safety has been linked to patient safety (Leroy et al., 2012). Thus, it is particularly meaningful in work environments in which team members' paramount concern applies to employees' or customers' physical safety, as is the case in health care industries and aviation industries (Newman et al., 2017). Accordingly, research on psychological safety focuses predominantly on teams in organizations linking psychological safety to antecedents and outcomes in order to help

teams become more effective.

In summary, psychological safety is a relational phenomenon that underlies the influence of time and changing interpersonal or environmental circumstances. Its benefits for teams and organizations are well documented, in particular, when the bonding between people plays a central role to produce a joint outcome (Edmondson & Lei, 2014; Newman et al., 2017).

1.2   Research Objectives

The purpose of this dissertation is to gain a deeper understanding of the dynamics of psychological safety and its effects on teamwork. With respect to the centrality of psychological safety for teamwork, the knowledge on how it forms and what factors influence its development is sparse. Thus, there is a discrepancy in knowledge and the genesis of empirical findings. This is exactly the starting point for this dissertation. The current work contributes to research on teams by putting psychological safety front and center in the examinations. Further, it considers the dynamic nature of psychological safety by embedding the research objectives into a more holistic theoretical framework on research of group dynamics by referring to research on group diversity and time as important factor for a team development. This work builds on 1) the model of group faultlines that explains dynamics of psychological safety across teams and members of subgroups, and on 2) the temporal approach to study time and changes of psychological safety in teams (Roe, Gockel, Meyer, 2012).

A large body of studies have accumulated knowledge on how a team members' shared belief of interpersonal risk-taking affects behaviors and outcomes such as individual job satisfaction, engagement, team learning, and team performance, just to state a few (Edmondson & Lei, 2014). Further, psychological safety is an important mediator or moderator for team processes. As such, psychological safety mediates the effects of team-oriented leadership behavior on trust and team effectiveness (Schaubroeck, Lam, & Peng, 2011). Whereas psychological safety is a boundary condition for the effects of task conflict on team performance (Bradley et al., 2012), there is little knowledge on the limits of psychological safety as most researchers focus on the positive effects of psychological safety perceptions on team outcomes (Newman et al., 2017). Further, conclusions on psychological safety are drawn from cross-sectional studies for the most part and treat psychological safety as static variable neglecting the dynamic nature of psychological safety. Thus, it is reasonable to raise the following questions.

First, what are boundary conditions of psychological safety? Psychological safety is conceptualized at the team level (Edmondson, 1999). Team members build on joint experiences, and thus, share the belief that it is safe to take interpersonal risks in the team. Edmondson (2002) found that teams differed in their assessment of team psychological safety, whereas members of

the same team showed an agreement. Yet, a network study of psychological safety demonstrated that single team members differed in their perception of psychological safety as if subgroups emerged (Schulte, Cohen, & Klein, 2012). This finding supports the theoretical assumption that psychological safety – as a team process – is influenced by subgroup dynamics. I refer to the model of group faultlines (Lau & Murnighan, 2005) suggesting that psychological safety will be diminished in teams with a strong faultline, a so called hypothetical line that splits a team into homogeneous subgroups based on multiple attributes (Lau & Murnighan, 1998). In this context, the leader plays a central role in the subgroup structure, as belonging to the leader's in-group as compared to an out-group is associated with higher exchange of resources and more benefits (cf. Leader-Member Exchange theory by Graen & Uhl-Bien, 1995). This work contributes to research on psychological safety by examining subgroup belonging as an important boundary condition of individuals' psychological safety beliefs thereby taking into account the effects of task conflict and faultline strength.

Second, how does psychological safety build and develop over time? This is important to examine because psychological safety is a dynamic concept by definition. However, former studies build on cross-sectional research treating psychological safety as a static variable examining it at one moment in time (Newman et al., 2017). Only two empirical studies addressed the question whether psychological safety changed over time leading to controversial findings. As such, psychological safety did not change at all or slightly decreased over the time of collaboration (Edmondson & Mogelof, 2005; Schulte et al., 2012). Thus, future studies should conceptualize psychological safety in a more dynamic way, providing a theoretical background on how psychological safety builds and develops embedded in a longitudinal design. This conclusion is in accordance with Edmondson and Lei's (2014) call for a more holistic examination on dynamics of psychological safety perceptions over time. Thus, I developed a theoretical framework and examined the effects of time on the development of psychological safety in teams with a clear project beginning and ending. This way, I aim to contribute to the clarification of this question.

Third, which antecedents predict initial levels and changes of psychological safety over time? Once more, researchers stressed the importance of group diversity for the formation of psychological safety (Lau & Murnighan, 2005). Accordingly, demographic faultline strength affects team processes and, thus, psychological safety right from the start. Because group dynamics are conceptually bound to team members characteristics (Hoyle & Crawford, 1994), I examined demographic faultline strength and deep level group diversity as antecedents for the formation and development of psychological safety in self-managed teams with a clear project beginning and ending.

Fourth, might the development of psychological safety be supported in a systematic way? By acknowledging inter-individual and temporal dynamics of psychological safety, I aim to refine

conclusions on *how* and *when* interventions to enhance psychological safety and team performance eventually are more effective.

1.3   Structure of the Dissertation

In Chapter 2, I lay the theoretical foundation of the dissertation by defining psychological safety, distinguishing it from trust, and explaining how it is measured. In Chapter 3, I summarized the existing body of literature on psychological safety by presenting selected findings about psychological safety thereby highlighting important questions that guide the current research. I draw conclusions from the reviews by identifying misfits regarding the theoretical conceptualization of psychological safety, consecutive methodological operationalizations limiting the validity of the conclusions drawn from these studies.

In Chapter 4, I present the theoretical framework for the three empirical studies in this dissertation. This work builds on the theories of group diversity and group faultlines that bear the potential to explain dynamics of psychological safety due to the existence of subgroups. Further, this work follows the temporal approach, a strong approach by Robert Roe (2008) calling for the inclusion of time in theoretical and methodological considerations when doing organizational research. Following, I present the research program of this dissertation. More importantly, I integrate the three studies under the umbrella of the effects of subgroup dynamics and time on psychological safety. Finally, I illustrate the unique scientific contribution that these studies provide for the field.

In Chapters 5 through 7, I present the three empirical studies in detail, when in Chapter 8, the general integration and subsequent discussion of the findings will follow. Both theoretical and practical implications are derived from the studies' findings. Also, strengths and limitations of the dissertation are discussed along with future research suggestions and a closing statement.

2   Conceptual Clarifications

2.1   Psychological Safety in Teams

Amy Edmondson (1999) defined *team psychological safety* as "a shared belief that the team is safe for interpersonal risk taking" (p. 354). By perceiving the team as psychologically safe, team members are confident that the team reacts in an open-minded non-evaluated way to critical requests and does not sanction single individuals with status losses (Edmondson, 2002). Further, psychological safety refers to

individuals' perceptions about the consequences of interpersonal risks in their work environment. It consists of taken-for-granted beliefs about how others will respond when one puts oneself on the line, such as by asking a question, seeking feedback, reporting a mistake, or proposing a new idea. (p. 6, Edmondson, 2002)

Most importantly, psychological safety helps team members overcoming status differences because it shifts the focus from self-protection and defensive reactions to a problem-solving orientation allowing discussions to be fruitful instead of becoming complaining circles or personal attacks (Edmondson, 2002; Nembhard & Edmondson, 2006). Such as climate enables team members to feel comfortable and to be themselves. Thus, it is an important requirement for sharing knowledge and performing together (Edmondson, 2002).

The theoretical roots of psychological safety beliefs lie in Social Identity Theory (SIT, Tajfel & Turner, 1986) applied to team work in organizations. According to this theory, individuals strive for a positive self-identity and thus protect a once-established image towards themselves and others (Goffman, 1955; Tajfel & Turner, 1986). According to Edmondson (2002), individuals have the following concerns on how others could evaluate their behavior when working together: They are afraid of being judged as ignorant, incompetent, negative or disruptive. Thus, individuals fear the consequence of being seen as weak when admitting a mistake; or to place themselves into an outsider position by conflicting with someone else's opinion or speaking one's mind in front of the team, which might have severe consequences for their employment. Thus, mistakes and their rapid consequences are often covered in organizations with severe consequences in the long run. In addition, teams and organizations miss the chance to learn from them and to improve their work.

Edmondson based her definition on Schein's and Bennis' work (1965) and William

A. Kahn's work (1990). Schein and Bennis defined psychological safety as the extent to which individuals are secure and confident to cope with change. This definition is rather broad focusing on an employee's working ability and capacity in general. Kahn (1990) links psychological safety to specific situations, in which an employee might be afraid "of negative consequences to self-image, status, or career", and thus, one might not feel comfortable to show one's self at work (Kahn, 1990, p. 708). In this definition, the affective component is emphasized more and the concept of authenticity at work is more central. Further, an employee's behavior is linked to potential consequences through a specific person, team member, or organization's norm. Building on these elaborations, Edmondson (1999) emphasizes the work in groups or teams thereby referring to specific learning behaviors that are important for organizations such as addressing problems, asking for help, or admitting mistakes that are associated with psychological safety.

Team Psychological safety is theoretically build on trust (Edmondson, 2002). Although psychological safety and trust have a strong theoretical overlap, Edmondson (2002) distinguishes them from one another on a conceptual level.

2.2   Definition of Work Teams

One big challenge of organizations was and still is the implementation of teamwork in organizations (Devine et al., 1999; Lay, Jung Erceg, & Schat, 2011). Today, teamwork is prevalent in all major organizations gaining in importance as work tasks become more complex and cross-linked in our society. According to a survey conducted by the Fraunhofer-Institut for research on systems and innovations in 2009, 60 percent of the German manufacturing industry used work teams (the term was not defined in detail). In organizations with a size of 1.000 employees and more, 90 percent of the organizations used work teams (Lay et al., 2011).

In order to understand the specific team features of psychological safety, it is important to define the term work team. A *work team* is a group of individuals who consider themselves a social entity (Alderfer, 1977). As such, in-group members and individuals outside have a clear understanding of who belongs to the team and who does not (Guzzo & Dickson, 1996). Work teams are interdependent in their performance towards a common goal and they are embedded in larger social systems like organizations or communities. Thus, other parties, e.g. other teams, or customers, are dependent or at least affected by the team's outcomes. Teams need to accomplish various goals, such as providing an organizational product, plan, decision, or service (Devine et al., 1999). By performing an

interdependent task, team members rely on each other in a unique way. Thus, members of a team should share a sense of joint commitment and pursue synergistic effects in order to be productive (Katzenbach & Smith, 1993). Although often used interchangeably in the literature, some authors differentiate between the terms "group" and "team". According to Greenberg and Baron (2000), teams compared to groups are exceedingly characterized by their members' complementary skills, work-focused interdependence, and their resulting strong involvement in a common task. As team members are subject to the same internal and external factors, they develop similar team and work values, norms, and beliefs based on joint perceptions of the leader's and team members' actions and consequences.

2.3   Differences Between Psychological Safety and Trust

Edmondson (2002, p. 7) considers " a climate of interpersonal trust and mutual respect" as the basis for the team belief psychological safety. Yet, psychological safety differs from trust in three respects: in the level of analysis, in the time horizon, and in the object of focus.

Trust is defined as

the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party. (Mayer, Davis, and Schoorman, 1995, p. 712)

The concepts of psychological safety and trust both encompass the individual's vulnerability and the consequent choice of risk-taking. Further, both concepts have been shown to have positive effects for work teams and organizations (e.g., Costa, Roe, & Taillieu, 2001), yet they might be distinguished from one another.

Level of Analysis. Most importantly, psychological safety is considered a team-level construct (Edmondson, 2002). Edmondson found that team members reported similar assessments of psychological safety and, thus, is related to all members shaping the belief by their actions and non-actions and norms. Interpersonal trust refers to a dyadic setting, where one person is vulnerable to the potential actions of another specific person.

Temporal Immediacy of Consequences. Perceptions of psychological safety should be activated and implicitly calculated in situations where short-term vs. long-term consequences are evaluated. As such, Edmondson (2002) describes that a nurse could report a mistake for sake of the patient's future health, or her own *immediate* benefit (not being scolded or "put to trial"). If it were not safe enough to speak up, the nurse would rather

remain silent accepting the patient's harm that is caused by this choice. Unlike psychological safety, trust is the concept that helps calculating fare choices that are more distant, thus, it encompasses a wider temporal range.

Focus on "Self" vs. "Other". When deliberating what to do, team members focus on own actions and their consequences and on others' actions and their consequences. Edmondson (2002) describes that psychological safety means, "whether others will give *you* the benefit of the doubt" (Edmondson, 2002, p., 9, emphasis in the original). In contrast, "trust involves giving others the benefit of the doubt" (Edmondson, 2002, p.8). Thus, psychological safety and trust differ in the leap of faith team members give vs. get.

Only one study supports the idea that psychological safety and trust are intertwined, and yet different from one another. In a study on R&D teams (Research & Development teams), psychological safety was significantly positively associated with relational capital (*r* = .23, Gu, Wang, & Wang, 2013). Relational capital was described as a mutual trust climate and measured with three items, namely "Team members have mutual trust", "Team members are open to try out new ways of doing things", and "Team members are supportive to change"). Other researchers focused stronger on the link between trust in the leader (e.g., Li & Tan, 2012; Schaubroeck et al., 2011), or trustworthiness into new members and psychological safety (Roussin & Webber, 2012).

In summary, both concepts are closely connected with each other, and perceived trust fosters a climate of psychological safety (Kahn, 1990). An empirical test of the differences between psychological safety and trust, more specifically between team psychological safety and team trust and the further the development of both processes, are yet to come.

2.4 Measuring Psychological Safety in Teams

Psychological safety is conceptualized as a construct on team level and is operationalized as such. Most researchers used the Team Psychological Safety scale developed by Edmondson (1999) to measure psychological safety by asking team members to assess their joint perceptions (TPS; Edmondson, 1999; Kayes, 2006; Tucker, 2007; Bossche et al., 2006). Other researchers used a slightly modified version of the TPS at the organizational level (e.g., Baer & Frese, 2003; Carmeli, 2007), or manager-focused assessments (Edmondson & Woolley, 2003). Only few studies used a qualitative approach by conducting interviews coding the statements as psychologically safe (Edmondson, Bohmer, & Pisano, 2001).

May et al. (2004) referred to psychological safety as it was described by Kahn (1990), and used three items to assess the concept independent of the team context. Others again combined the two scales (Schepers, De Jong, Wetzels, & De Ruyter, 2008), or developed their own scales to measure psychological safety (e.g., Tynan, 2005) using another concept such as trust as proxy to a climate of psychological safety.

A list of the most cited scale TPS that measures psychological safety on team level, and the scale developed by May et al. (2004) that measures psychological safety based on Kahn's (1990) work are presented in Table 1. In addition, I present the Participative Safety Scale developed by Anderson and West (1994, 1998), which is a subscale of the team climate inventory. It was used in seven studies to measure psychological safety and, thus, is an alternative validated measure to the TPS (Newman et al., 2017).

Because there is such a big variety in how psychological safety is measured, it is difficult to generalize findings from different studies, and, thus, Newman et al. (2017) recommend to use the Team Psychological Safety Scale (Edmondson, 1999). When developing the measure, Edmondson tested the internal and discriminant validity in respect to the constructs team learning and team performance. Cronbach's alpha was acceptable to good in most published studies, although the number of items used varied across the studies from 1 item to 4, 5 or 6, and 7 items, which could be a sign for a lack of internal validity. Up to date, there is no published empirical work embedding the Team Psychological Scale into a nomological network. Thus, more research is required focusing on the usage and validation of the TPS in different countries in regards to similar scales measuring psychological safety, similar concepts such as trust, different concepts such as team learning, voice, silence, and outcomes such as team performance.

Table 1

Frequently Used Scales to Measure Psychological Safety

Measure	Number of items	Item wording	
Team Psychological Safety Scale (Edmondson, 1999)	7	1	If you make a mistake on this team, it is often held against you. (R)
		2	Members of this team are able to bring up problems and tough issues.
		3	People on this team sometimes reject others for being different. (R)
		4	It is safe to take a risk on this team.
		5	It is difficult to ask other members of this team for help. (R)
		6	No one on this team would deliberately act in a way that undermines my efforts.
		7	Working with members of this team, my unique skills and talents are valued and utilized.
Psychological Safety Scale (based on Kahn (1990), developed by May, Gilson, & Harter, 2004)	3	1	I'm not afraid to be myself at work.
		2	I am afraid to express my opinions at work. (R)
		3	There is a threatening environment at work. (R)
Team Climate Inventory, Subscale Participative Safety (Anderson &West, 1994)	20	1	We share information generally in the team rather than keeping it to ourselves.
		2	We have a 'we are in it together' attitude.(*)
		3	We all influence each other.
		4	People keep each other informed about work-related issues in the team. (*)
		5	People feel understood and accepted by each other. (*)

6	Everyone's view is listened to even if it is in a minority.
7	There are real attempts to share information throughout the team. (*)
8	There is a lot of give and take.
9	Disagreeing with another's idea is not a rejection of that person.
10	People try to control each other. (R)
11	We try to blame each other. (R)
12	How friendly or easy to approach are the people in your team?
13	To what extent are the members of your team critical of new ideas? (R)
14	How threatening do you find putting forward new ideas to the team? (R)
15	How supportive are the other members of your team?
16	To what extent is there feeling of trust between members of your team?
17	To what extent are persons in your team willing to listen to your problems?
18	To what extent do others foster an atmosphere of non-threatening co-operation amongst members of the team?
19	To what extent do you feel at ease with the members of your team?
20	Do other members have a genuine concern over your personal well-being?

Note. Items marked with an R in parentheses are reverse scored. Items 1–14 of the scale Participative Safety belong to the subscale Participation, whereas items 15–23 belong to the subscale Participation. Items marked with an asterisk belong to a valdiated short version of the Participative Safety scale (Kivimäki & Elovainio, 1999).

Recently, Roussin, MacLean, and Rudolph (2016) suggested a multi-level approach based on social network theories to better map the possible differences between members or respective subgroups thereby putting the focus particularly on teams with a lack of psychological safety. The authors thus refer to teams whose members do not agree in their overall perceptions of psychological safety. The benefit of this approach lies in the identification of subgroup structures and different subgroup climates. This is important, as a team might assess psychological safety low when referring to the entire team. Yet, if team members assess their subgroups, both subgroups might be characterized by a high psychological safety. Figure 1 illustrates this example. The authors suggest that in this example, leaders could use their knowledge to distribute tasks in accordance with the subgroup structure. Further, the leader's position in the subgroup structure can be determined. In this example, the leader is part of one subgroup and a single tie links both subgroups, which are similar in subgroup size and intact in their psychological safety perceptions. However, the leader might as well be unrelated with both subgroups, a star in the network, where team members are unrelated with each other or where team members build a majority against a minority. The leader might as well be linked to one or two team members separated from the rest of the team. Dependent on the subgroup structure and the leader's position, interventions should be focused more on the leader or on specific subgroups, or individual team members.
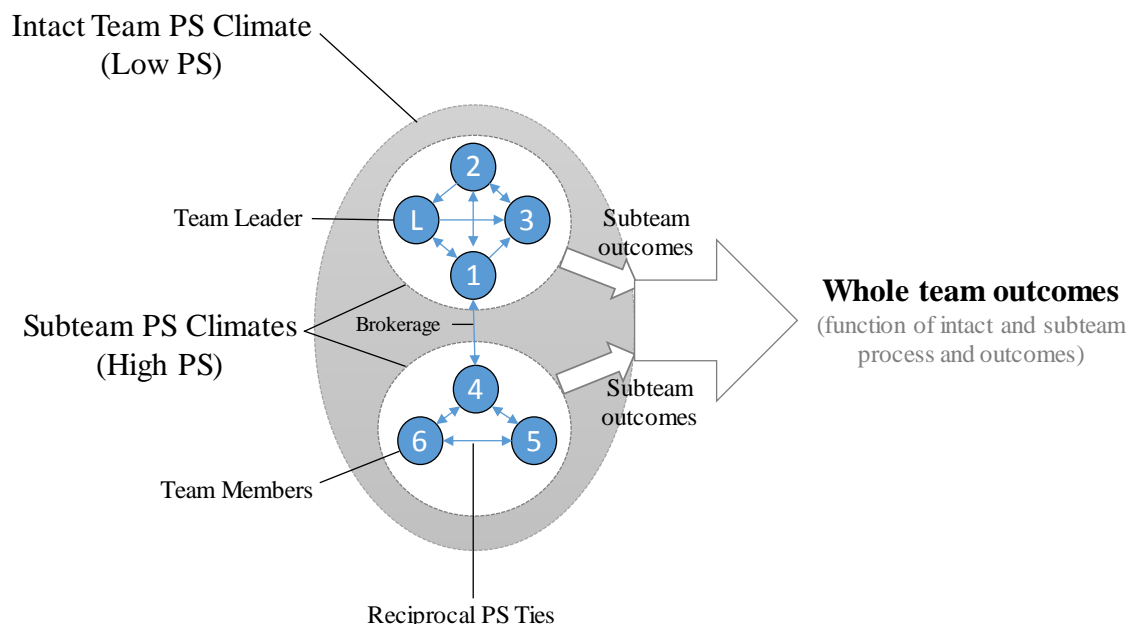
Figure 1. Multilevel Team Psychological Safety (PS) Climates and Performance Outcomes (Own Figure, Taken from Roussin et al., 2016, p. 1414)

This approach might be used to measure psychological safety as follows: First, every team member rates each member based on the two or three items taken from the TPS scale (Edmondson, 1999). Next, reciprocal ties among members or members and team leaders are analyzed by calculating density and centrality. This way, researchers provide indices that reflect *member-only PS density*, *subteam PS*, and *leader PS centrality* allowing to investigate noticeable differences in individuals assessments, subgroup assessments and overall team assessments. Second, because network data collection is impractical in some situations, and if teams operate in subgroups that are not likely to fall apart in further subgroups, team members might assess their subgroup psychological safety by answering the TPS scale with regard to their specific subgroup.

Taken together, most researchers used the measure provided by Edmondson (1999). Yet, even within recent publications, there is a variety of other scales used to measure psychological safety, and further developments such as network indices are forthcoming. Thus, a validation study of the TPS scale and translation into other languages would be a valuable contribution to clarify measurement issues and recommendations for researchers that are interested in team or subgroup psychological safety.

3   Antecedents, Outcomes, and Boundary Conditions of Team Psychological Safety

An extensive body of literature has grown on the relation of antecedents, outcomes, and boundary conditions of psychological safety. There are over 83 published articles – by the end of 2015 – including a meta-analysis of the relationships between psychological safety on the one hand and team learning – as well as team performance on the other hand (35 studies, Sanner & Bunderson, 2013), a meta-analysis on the antecedents and outcomes of psychological safety (Frazier et al., in press), a first review on psychological safety literature including all levels of analyses (30 studies, Edmondson & Lei, 2014), and a systematic review on psychological safety literature including possible negative effects for organizations (83 studies, Newman et al., 2017). Based on these studies, the most important outcomes, antecedents, and boundary conditions of psychological safety are summarized.

3.1   Outcomes of Psychological Safety

The majority of the studies on psychological safety examined the positive effects of psychological safety on organizational outcomes (in sum 62 studies). The beginnings of research on psychological safety, and, thus, the larger body of literature focuses on the effects of psychological safety on team learning and team performance (e.g., Edmondson, 1999; Schaubreock, et al., 2011). In this context, there are several models of team learning identifying this variable as important mediator of the relationship between psychological safety and team performance (see e.g., the meta-analysis by Sanner & Bunderson, 2013). Further studies examined creativity as one important dimension of team or firm performance (e.g., Baer & Frese, 2003; Carmeli, Reiter-Palmon, & Ziv, 2010; Gu et al., 2013). Thus, psychological safety might strengthen employees' identification with their organization, fostering social exchange and finally creativity.

Some researchers asked employees to assess their psychological safety in their organization linking it to firm performance in terms of stronger innovation climates and higher creativity (e.g., Baer & Frese, 2003; Carmeli, 2007). However, Newman et al. (2017) stress that psychological safety is a construct on team level, and if organizational outcomes are of interest, psychological safety seems to be more important in small organizations due to stronger ties between the organization's' members.

With an increased embedment into social learning and exchange theories, other outcomes such as communication, increased error reporting, knowledge sharing, voice behavior, employee attitudes, and other related variables such as providing feedback, came to the fore (e.g., Carmeli, 2007; Edmondson, 1996; Liu et al., 2014; May, et al., 2004). However, psychological safety was not linked to higher levels of critical thinking – an often implicit proposition in researchers' theoretical framework (Kayes, 2006).

3.2   Antecedents of Psychological Safety

Researchers' interest rose in identifying antecedents of psychological safety (44 studies). For the most part, these studies focused on psychological safety as an important mediator to explain how leadership behavior, relationship networks, team characteristics, individual vs. team differences, or organizational practices affected relevant organizational outcomes on all levels of analyses. Researchers built their considerations on established theories such as social learning theory, social exchange theory, social identity theory, and status characteristics theory.

3.2.1   Leadership Behavior

In her early work, Edmondson stressed that both leader and team members shape perceptions of psychological safety. In more than 22 studies, researchers focused on the leader by examining the effects of supportive leadership behavior on work outcomes mediated by psychological safety beliefs. In sum, there is empirical evidence that employees' perceptions of psychological safety are strengthened if they perceive their leaders as inclusive (Bienefeld & Grote, 2014; Carmeli et al., 2010), supportive (May et al., 2004), trustworthy (Madjar & Orit-Walters, 2009), open (Detert & Burris, 2007), or to behave with integrity (Palanski & Vogelgesang, 2011). Psychological safety again was related with more voice behavior, creativity, job engagement and job performance. Similarly, leadership behaviors such as transformational leadership (Nemanich & Vera, 2009), change-oriented leadership (Ortega et al., 2014) and shared leadership (Liu et al., 2014) were related with more voice and learning behaviors mediated through psychological safety perceptions.

On the team level, team members' shared perceptions of psychological safety were linked to perceived leader support and coaching (Edmondson, 1999; Roberto, 2002), trust in the leader (Li & Tan, 2012; Schaubroeck et al., 2011), and the behavioral integrity of the leader (Leroy et al., 2012). Further, psychological safety was the explaining mechanism how supportive leadership behavior influenced outcomes on the team level such as team learning, performance, engagement in quality improvement at work, and the reduction of errors. Besides several leadership concepts and styles that include some recommendations how leaders should behave in order to foster the development of psychological safety, the method how leaders reach team members is important. By comparing the dyadic discovery vs. a group-based discovery, Roussin (2008) recommends that in cases of interpersonal tensions, team leaders might have better access to their team members and, thus, are more likely to create a psychologically safe climate by individually talking to each member instead of talking it over in front of the entire team. Researchers referred to social learning theory and social exchange theory to explain the relation between leadership behavior, the development of psychological safety, and effects on organizational outcomes. However, Newman et al. (2017) emphasized a leader's role model so that employees build psychological safety through learning, e.g. by experiencing and producing inclusive behavior themselves in a critical situation, rather than by displaying supportive behavior at any point in time, which could be perceived as acting or unauthentic over time.

3.2.2 Relationship Networks

Besides the leader, the closeness to colleagues and team members is found to be a key factor for psychological safety. Throughout all levels of analyses, the quality of the social interactions and perceived social support have been linked to psychological safety in a positive way (e.g., Carmeli, 2007; Carmeli & Gittell, 2009). On the team level, the quality of relationships among team members and outside parties (Brueller & Carmeli, 2011), or in form of network ties (Schulte et al., 2012), trust (Gu et al., 2013), or familiarity (Roberto, 2002) foster team psychological safety and in turn team learning, performance, or innovation. Burris et al. (2009) found that members belonging to an inner circle vs. an outer-circle of the leader (operationalized as being a friend vs. stranger in studies 1 and 2, and based on the extent to which the supervisor liked the subordinates in study 3) felt more psychologically safe and participated in the discussion to a higher extent while receiving more rewards in return.

3.2.3 Team Characteristics

At the team level, psychological safety was linked to team characteristics such as team structures (e.g., higher levels of specialization, formalization, and hierarchy, Bresman & Zellmer-Bruhn, 2013; Bunderson & Boumgarden, 2010), shared rewards (Chen & Tjosvold, 2012), and team engagement in the improvement of work conditions (boundary work, Faraj & Yan, 2009). Further, Lau and Murnighan (2005) found that psychological safety depended on the strength of group faultlines, hypothetical lines that split a team into subgroups along a set of demographic attributes (Lau & Murnighan, 1998). However, the findings did not match their expectations: In teams with strong faultlines, psychological safety was higher compared to teams with weak faultlines. The authors discussed that the positive social effects in the specific subgroup might have spread to the entire team buffering the supposed negative effect of faultline strength on psychological safety. Further, team autonomy in R&D teams (Chandrasekaran & Mishra, 2012) only affected psychological safety and work outcomes under certain conditions, such as when project goals were matched with organizational goals, and teams showed less explorative behaviors.

Furthermore, two studies demonstrate the importance of team characteristics for the effects of psychological safety on outcomes. First, psychological safety promoted commitment escalation, when team members were individually held responsible for a bad investment decision, compared to when team members shared responsibility (O'Neill, 2009). Second, teams high in

utilitarianism (a strong focus on own advantages), were more likely to engage in unethical behavior like cheating, if psychological safety levels were high (Pearsall and Ellis (2011).

3.2.4   Individual Differences and Perceptions of Organizational Practices

Individual differences such as perceived status (Bienefeld & Grote, 2014; Nembhard & Edmondson, 2006), self-consciousness, team-norm orientation (May et al., 2004), or team differences, e.g. regarding team members' thinking styles (Post, 2012) were associated with psychological safety. Further, supportive organizational practices such as perceived organizational support (Carmeli & Zisu, 2009), access to mentoring (Chen, Liao, & Wen, 2014), and diversity practices (Singh et al., 2013) have been shown to positively affect employees work outcomes such as organizational commitment and job performance, mediated through perceptions of psychological safety.

3.3   Psychological Safety as Boundary Condition

Researchers are increasingly focusing on contingencies, identifying psychological safety as one important moderator in the interplay of antecedents and outcomes at work. For instance, when teams reported high levels of psychological safety, team diversity expertise and task conflict were positively related to team performance (Bradley et al., 2012; Martins et al., 2013). Furthermore, the negative effects of national diversity, geographical dispersion, and other structural features on team innovation are diminished (Gibson & Gibbs, 2006), whereas nationality diversity has a curvilinear relation with team performance (Kirkman et al., 2013).

In summary, an extensive amount of studies have contributed to illustrate how psychological safety relates to other organizational concepts thereby stressing the importance of psychological safety for teamwork in particular. An overview of the network of key variables related to psychological safety are depicted in Figure 2. The colored boxes show how the three studies conducted in this dissertation add to the previous work on psychological safety.
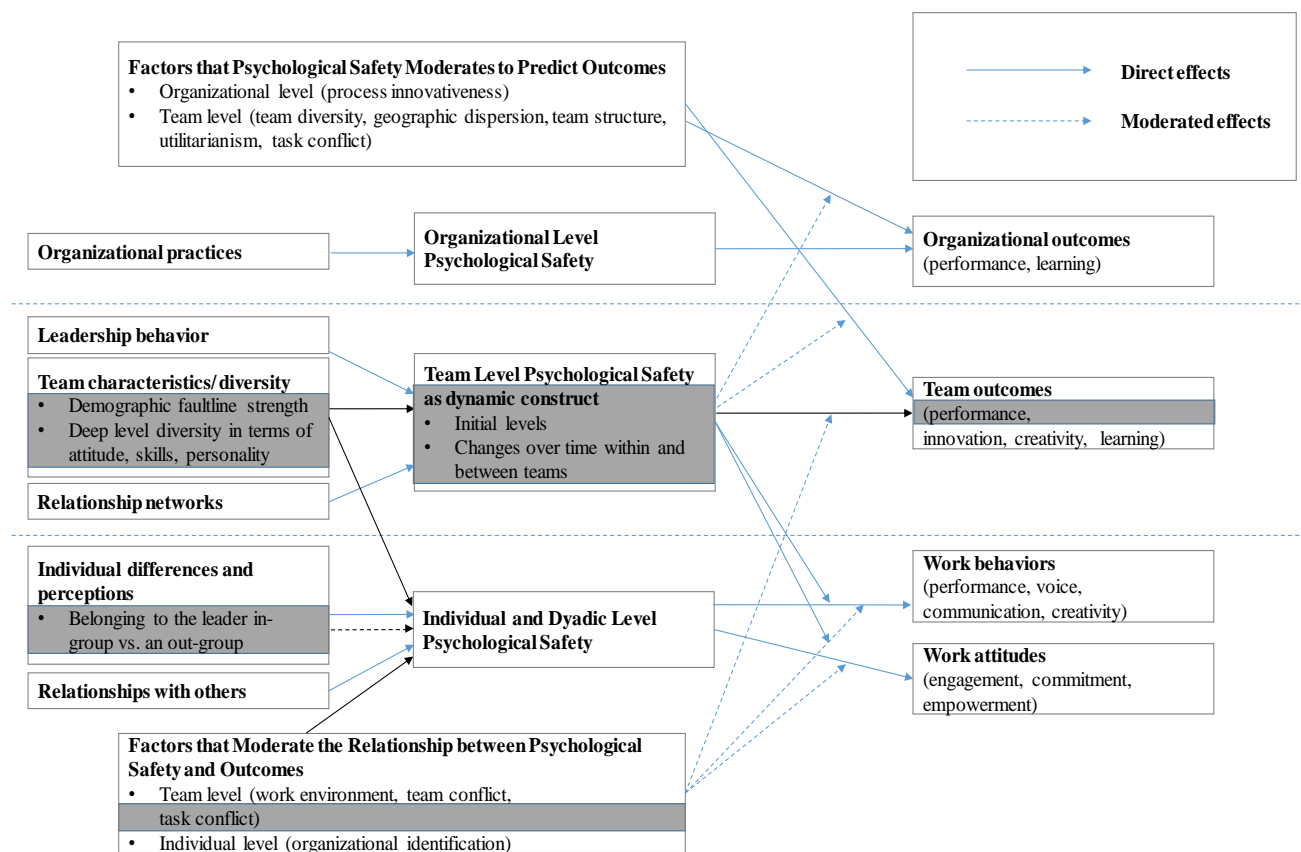
Figure 2. Network of Key Variables Related to Psychological Safety Based on Literature Review (Own Figure Based on Newman et al., 2017, p. 529).

3.4   Evaluation of the Previous Research, Future Directions, and Contributions

Overall, a remarkable number of studies demonstrated the relevance of and increasing interest in psychological safety as a valuable resource at work. Psychological safety appears to be a meaningful mechanism that transmits or strengthens the positive effects of antecedents on relevant organizational outcomes. Yet, studies focused on psychological safety as antecedent, moderator, or mediator, and less on psychological safety as one an important outcome itself (Edmondson & Lei, 2014; Newman et al., 2017). Further, research on psychological safety has been embedded in theories of social learning, social exchange, and social identity theories (Newman et al., 2017). There is a lack of theoretical work contributing to explain how and why psychological safety affects work-relevant outcomes. Alternative approaches might contribute

to gain a deeper understanding of the development of psychological safety, or to understand interpersonal dynamics such as under which circumstances team characteristics such as personality factors influence perceptions of psychological safety. Thus, theories such as the model of group faultlines (Lau & Murnighan, 2005) and the temporal approach (Roe, 2008) might contribute to a more holistic picture of psychological safety including boundary conditions of the concept. There is a lack of longitudinal designs allowing testing for dynamic processes of psychological safety. As such, researchers treated psychological safety as a static variable, for instance by investigating it at an arbitrary random point in time. Only two studies had used three measurement points to test for changes of psychological safety related to team members' friendship ties (Schulte et al., 2012) and the effects of team characteristics such as personality, team resources and goal clarity on initial levels of psychological safety and psychological safety at midpoint and at the end of a project (Edmondson & Mogelof, 2005). Yet, the studies' results are inconsistent and do not provide an explanation of the findings regarding the effects of time on perceptions of psychological safety.

Therefore, the dynamic nature of psychological safety needs to be addressed in future studies. Further, antecedents that explain differences between team members such as cross-level interactions due to subgroup dynamics, and changes within teams over time contribute to the understanding of how psychological safety develops and how the development affects organizational outcomes. These conclusions are supported by Edmondson and Lei's (2014) claim to focus on the dynamics of psychological safety; and by Newman's et al. (2017) critical view on the limited research bounded by the level. The authors suggest spanning boundaries by investigating how variables from different levels interact and influence the outcomes.

4   The Current Research

4.1   Contributions

First, the current research contributes to previous research on psychological safety by putting psychological safety front and center in the present research. Second, I address the boundary

conditions of psychological safety. As such, this work examines subgroup belonging as important antecedent for how leaders and team members jointly influence the formation of perceptions of psychological safety and where they reach their limits. In this context, I build on theories of group faultlines and subgroup dynamics due to group diversity (e.g., Carton & Cummings, 2012; Lau & Murnighan, 2005) in combination with the Leader-Member-Exchange theory. Third, this work

examines psychological safety by using a longitudinal design (in two out of three studies) and sophisticated methods such as multilevel modeling, growth curve modeling, and the intra-team longitudinal approach by Li and Roe (2012). This way, I take into account natural team development processes by examining the effects of time and potential subgroup building due to demographic group faultlines as antecedent for the formation of psychological safety. Further, this work focuses on what members bring into the team by examining deep level group diversity as antecedents of the development of psychological safety. Therefore, I follow the temporal approach as theoretical framework (Roe et al., 2012), which allows us to specifically address group dynamics and changes *over time* in psychological safety. Further, I tested for the unique influence of changes in psychological safety on team outcomes such as team performance. This way, I aimed to gain a deeper understanding in how and when an increase, stability, or drop of team psychological safety relates to team effectiveness. Fourth, this work provides empirical evidence to draw implications of how and when to foster the development of psychological safety in teams.

4.2   Theoretical Framework of the Dissertation

The following studies are based on two fundamental theoretical considerations. First, I refer to diversity research, more specifically to the model of group faultlines developed by Dora C. Lau and J. Keith Murnighan (1998, 2005). Second, I consider the effects of time and changes in team perceptions of psychological safety inspired by Robert Roe's temporal approach (2008) that significantly shaped this work's design and spirit.

What differences make a difference? Under this headline, Elisabeth Mannix and Margaret A. Neale (2005) discuss the promise and reality of diverse teams in organizations. Managing diversity rose to a central challenge of organizations due to an ageing society and growing lack of workers and specialists in the workforce. Diversity is defined as "any attribute that another person may use to detect individual differences" (Williams & O'Reilly, 1998, p. 81). This definition is quite broad including attributes that may be superficial and detectable at once such as gender or age, and deep level attributes that may become important during collaboration over time such as team members' professional background, personality, or other interests. Further, this definition refers to a subjective perspective emphasizing the individual's attitudes, experiences, and naïve theories of how they perceive their environment and people. Diversity in teams has positive and negative effects based on the similarity– attraction paradigm (Byrne, 1971), the social identiy theory (Tajfel, 1978, and the self-categorization theory (Turner, 1982). In sum, these theories support the idea that individuals prefer working together with people that they perceive as similar

to them. However, a deep elaboration of information will more likely take place if team members have a diverse background and, thus, providing information that need to be critically evaluated. Research shows that diversity may improve decision making and problem solving (Watson, Kumar, & Michaelson, 1993), but it is also associated with reduced interpersonal liking, intergroup communication, and team cohesion (Smith et al., 1994; Tsui & O'Reilly, 1989; Tsui, Egan, & O'Reilly, 1992), and increased team conflict (Jehn, 1995). For a long time, different conceptualizations and measurements have led to an enormous body of inconsistent findings integrated for the first time by the theory and unified measurement of group faultlines (Thatcher & Patel, 2012). The term of group faultline is originated in the boundary zones between the tectonic plates of the continents and describes a hypothetical line that potentially splits a team into subgroups according to team members' similarity along a set of multiple attributes (Lau & Murnighan, 1998). For example, if two young women start working together with two elder men belonging to the organization for a longer time, this team would have a strong demographic faultline causing two most homogenous subgroups to emerge, namely the subgroup of young females entering the organization and experienced men with tenure. According to the *model of group faultlines*, the strength of a team's faultline has a negative impact on team processes and outcomes such as internal team conflict, team learning, psychological safety, satisfaction, and anticipated performance (Lau & Murnighan, 1998, 2005). The reason for the negative effects of faultline strength on psychological safety is rooted in team members' identification processes (Lau & Murnighan, 2005). Thus, in teams with a strong faultline, team members are more likely to identify with the respective subgroup compared to the entire team, whereas in teams with a weak faultline, team members relate their identity to the entire team. This leads to a more segregated communication and information sharing restricted to the respective subgroup in strong-faultline teams. Yet, in teams with a weak faultline, Lau and Murnighan (2005) argued that a team could act more united and learn through active feedback seeking and giving. Thus, it may be easier to build a psychologically safe climate eventually reducing intra team conflict and enhancing team learning and performance.

A first experimental study supported the authors' propositions that members of teams with a strong faultline

> were biased toward individuals within their own subgroups in terms of group process and affect, suggesting that the members of strong-faultline groups identified socially not with the group as a whole but with their demographically similar subgroups (Lau & Murnighan, 2005, p. 654).

The effects of the faultline strength changed the locus of social identification in teams and, thus, influenced the teams' structure without being triggered or phenomenally salient. Further, the

authors discuss this finding by contrasting Allport's (1954) contact hypothesis and the assimilation model (Moghaddam & Solliday, 1991) to conclusions made by Sherif and Sherif (1953). Hence, contact between individuals that perceive each other as different or contact between different subgroups is not enough to reduce the effects of negative stereotypes or subgroup boundaries. Instead, they propose that

> strong-faultline teams might require truly common goals (e.g., defeating common enemies) or decidedly integrative tasks to overcome their decisive subgroup structure (Lau & Murnighan 2005, p. 656).

The theory of subgroups by Carton and Cummings (2012) supports this line of reasoning. Accordingly, subgroups that emerge due to identity- or knowledge-based differences (e.g., team members perceive differences in each other's values, knowledge, or responsibilities) develop "us vs. them" attitudes, because subgroup members perceive themselves as elementary different from other subgroups. These subgroups are more likely to experience identity threat (compared to resource-based subgroups), especially if they are of the same size, being compromised in their ability to develop an intact climate of psychological safety, which again is associated with less information sharing experimenting across subgroups.

Controversial to the model's propositions, however, faultline strength was found to be positively associated with overall psychological safety perceptions in a first study (Lau & Murnighan, 2005). One explanation is that the positive effects of subgroup identification were carried over to the entire team. However, future studies need to address this contradiction to shed light on the relation of faultline strength and psychological safety and mediating mechanisms. More specifically, group faultlines are relevant for the formation of psychological safety, as they instantly affect team processes (Lau & Murnighan, 2005).

Because psychological safety is a team process, it is inherently connected to the effects of time. Yet, most researchers treated psychological safety as a state by examining it at a random point in a team's life cycle. This contrast between the nature of group dynamics and the design used in most previous studies is called a problem-method misfit and can be solved by following the *temporal approach* in future studies (Roe et al., 2012). The temporal approach comprises the assumption that everything is subject to change and, thus, variables of interest such as psychological safety should be examined unfolding over time.

Only two studies investigated psychological safety by measuring it repeatedly at three points in time (Edmondson & Mogelof, 2005; Schulte et al., 2012). These studies reach different conclusions about the development of psychological safety – it remained stable, or decreased. Thus, in this dissertation, I shifted the focus towards the dynamics of psychological safety over time taking into account team development processes by examining changes in psychological

safety within teams across the entire life cycle.

Following the temporal approach (Robert Roe, 2008; Roe et al., 2012), I adhere to calls by team researchers for the inclusion of time in theoretical and empirical practices. Although early work on group dynamics in the 1940s is characterized by an explicit consideration of time (e.g., Bales, 1950; Lewin, 1947; McGrath, 1964), studies in the 1970s lack of this perspective by building their work on cross-sectional studies using differential statistics coming up according to the Input-Process-Output model. However,

> it is logically impossible to obtain knowledge about how a team changes by comparing different teams with each other. This explains why research based on the I-P-O model has helped little in gaining a better insight into process dynamics. (Roe et al., 2012, p. 633)

Instead, time broadens team research by spanning an additional dimension to investigate changes. In most studies researchers refer to processes that happen over time, however, processes were measured as if they were states. This "compression of processes into stable individual difference variables remains problematic, (…) as (…) one still draws upon between-teams covariance of variables, and not on within-team covariance over time"(Roe et al., 2012, p. 636).

To gain more insights into the relation between time and psychological safety, the following questions need to be addressed: how does psychological safety develop over time? What are antecedents for the formation and changes over time? How do changes in psychological safety in terms of an increase, stability, or decrease affect other important team processes such as team performance? To answer these questions, a clear time interval for the research is required (e.g., from onset to offset) allowing to "zoom" into the trajectories of psychological safety within a specific sensitive window of time. Therefore, I refer to the punctuated equilibrium model, a team development theory by Gersick (1988) focusing on project teams with a clear beginning and ending. She observed that teams progress in two phases of inertia, interrupted by a transition around midpoint. At *the first meeting*, team members agreed on a task definition or planned how to approach the project at the first meeting. In *phase 1*, the team stick to this framework, worked out details, and argued about these. The *transition* was characterized by a radical change such as revising a first draft and making a second plan, redefining the task or goals. In *phase 2*, team members again worked out details, or referred to supporting systems such as consultants in order to finalize, edit, and *complete* the project in time. Following the equilibrium model, at least three reference points in time are important to display changes of psychological safety: The beginning, the midpoint, and the end. In sum, this model emphasizes the importance of time for team development, as team members are aware of the time constraints undergoing a transition process around midpoint that marks an opportunity to change course direction radically.

4.3   Overview of the Research Program

Building on the tremendous research of psychological safety, I shift the focus to the dynamics of psychological safety. This is important because psychological safety is a changing process by definition. I will outline the research program of this dissertation which comprises three empirical studies. The titles, co-authors and progress of submission is reported in Table 2.

Table 2

Overview of the Studies of the Dissertation

Study 1	Gerlach, R. & Gockel, C. (2017). We belong together: Belonging to the principal's in-group protects teachers from the negative effects of task conflict on psychological safety. *Revise and Resubmit of the Journal of School Leadership & Management*
Study 2	Gerlach, R., & Gockel, C. (2017). A Question of Time: Effects of Time, Demographic Faultline Strength, and Deep-Level Group Diversity on the Development of Psychological Safety *Submitted to the European Journal of Organizational and Work Psychology*
Study 3	Gerlach, R., Gockel, C., Cook, A. (S.), & Dilba, D. (2017). A Change Would Do You Good: Initial Levels and Changes of Psychological Safety in the First Half of Teamwork Predict Team Performance *Submitted to the Journal of Applied Psychology*

An overview on the research objectives, designs, and participants is available in Table 3. Table 4 illustrates the theoretical and methodological approaches, calculation methods, the levels of analyses considered and the outcome measure used across the empirical studies.

Table 3

Research Objectives of the Dissertation

	Objectives		Design		Participants	
	Subgroup Dynamics	Temporal Dynamics	Cross-Sectional	Longitudinal	Field	Research Teams
Study 1	●		●		●	
Study 2	●	●		●		●
Study 3		●		●		●

Table 4

Overview of the Research Program

	Theoretical Approach	Methodological Approach		
		Calculation Method	Levels of Analysis	Outcome Measure
Study 1	Leader-Member-Exchange Theory, Model of Group Faultlines, Group Diversity	Multilevel Modelling	Individual/ Organization	Self-Assessment of Psych. Safety
Study 2	Model of Group Faultlines, Group Diversity, Temporal Approach	Growth Curve Modelling	Time/ Individual/ Team	Self-Assessment of Psych. Safety
Study 3	Temporal Approach, Compositional Impact of Team Diversity on Performance	Intra-Team Longitudinal Approach	Team Trajectories/ Team	Supervisor-Reported Team Performance

Study 1, entitled "We belong together: Belonging to the principal's in-group protects teachers from the negative effects of task conflict on psychological safety", centers on different effects of task conflict on members' perceived differences in psychological safety in a small organization (here: a school) based on members' closeness with the leader (here: the principal). Conflicts are critical events during collaboration processes and as such, they shape perceptions of psychological safety. Whereas relationship conflict has an overall negative effect on team[1] processes and outcomes, task conflict has shown to foster team performance under certain conditions such as when psychological safety is high (Bradley, Anderson, Baur, & Klotz, 2015). By drawing on a contingency approach of task conflict, we[2] identify a boundary condition of psychological safety, namely belonging to the leader's in-group vs. an out-group because being close to the leader is associated with more resource exchange and other benefits (c.f. Leader-Member-Exchange theory by Graen & Uhl-Bien, 1995). Further, we controlled for the negative effects of faultline strength, a hypothetical line that splits teams into homogenous subgroups according to demographic variables (Thatcher & Patel, 2012). In total, 244 teachers from 45 primary schools in Saxony/ Germany responded to our survey and were asked to state their intrateam conflict and psychological safety during the last four weeks. We used multilevel modeling to predict teachers' individual psychological safety. We found a direct negative effect of

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[1] In the respective studies, I referred either to teams, or to groups, dependent on the Journal, we were going to submit the manuscript.

[2] Although I conceptualized and conducted the studies, made the calculations and wrote numerous versions of the manuscripts, they would have never become what they are now without the collaboration and comments of my highly respected co-authors and colleagues. Thus, I use "we" when referring to the studies.

faultline strength on perceptions of psychological safety and a cross-level interaction: Subgroup belonging buffered the negative effects of task conflict on psychological safety, when members belonged to the leader's in-group compared to when members belonged to an out-group. This study demonstrates the interplay of leader and members' influence on how perceptions of psychological safety develop when intrateam conflict occurs. We draw recommendations for teachers how to deal with the effects of subgroup belonging in the presence of high task conflict.

In *Study 2*, entitled "A question of time: Effects of time, demographic faultline strength, and deep-level group diversity on the development of psychological safety", we investigated the development of psychological safety more holistically. As such, we describe the formation and changes of psychological safety across a team project, thereby predicting the development of psychological safety by group diversity variables and faultline strength. Again, we focused on the dynamics of psychological safety because low initial levels or a decrease over time are important key points for team interventions that have largely been neglected during past research (Edmondson & Lei, 2014; Newman et al., 2017).

Teams need to grow together; they need time to perform together in an effective way. According to the model of group faultlines, group diversity should affect initial levels and changes in psychological safety over time. We believe that faultline strength affects the formation of psychological safety, and that time and attitudes towards teamwork, abilities, and personality affect the development of psychological safety over time. These attributes have been shown to drive behavior that signals psychological safety to the team, such as asking for help, addressing problems and errors, or proposing unconventional ideas (e.g., Ulloa & Adams, 2004). Sixty-one teams with three to five members each participated in this study. They worked on a university research project, which was part of their curriculum, over five months. According to Gersick's team development theory (1988), we asked the teams to assess their psychological safety at the beginning (t1), in the middle of the project (t2), and at the end (t3). We used growth curve multilevel modeling to predict initial levels and changes in psychological safety, thereby controlling for diversity effects. Our results showed that in most teams, psychological safety decreased over time. Faultline strength had a marginally negative effect on initial levels of psychological safety, and attitudes towards teamwork had a positive effect: The stronger team members rated their attitudes towards teamwork, the higher they rated their initial psychological safety. Team members' skills and diversity regarding personality characteristics predicted changes in psychological safety: The higher team members rated their task-specific skills at the beginning, the more psychological safety decreased over time. The more similar team members were regarding their conscientiousness, the more psychological safety increased over time. Implications for team dynamics and interventions on time are discussed.

So far, we demonstrated that there are temporal dynamics of psychological safety, but are these the teams' individual changes important for team performance? In our third study, we analyzed trajectories of psychological safety as predictor for team performance.

In *Study 3,* our focus lay on the unique influence of changes of psychological safety on team effectiveness. We analyzed how trajectories of psychological safety (increase, decrease, or stability) was related to other-rated team performance. According to the punctuated equilibrium model of team development by Gersick's (1988) development theory, the midpoint of a team project is an important turning point and signals that time runs out. Thus, we asked whether changes in psychological safety during the first or second half of collaboration affected team performance. Fifty-nine research teams completed a research project over five months. We asked them to assess their psychological safety and team performance at five time points – trying to take a more detailed picture of how psychological safety develops over time. By means of the intrateam- longitudinal approach by Li and Roe (2012), we clustered psychological safety trajectories of the teams for the first half and for the second half of a team project. Results showed that initial levels of psychological safety *and* changes during the first half of the team project significantly predicted team performance. The higher psychological safety was at the beginning, and the more psychological safety increased ot remained stable (as compared to a decrease) in the first half of the team project, the better teams performed. We end by giving recommendations, when and how to intervene in teams according to Hackman and Wageman (2005), to enhance psychological safety when the team shows the necessary readiness for interventions.

Overall, this dissertation stresses the importance of changes in teams by considering psychological safety over time, and in connection with subgroup building, intrateam conflicts (only observable over a longer period of collaboration), and group diversity effects on initial levels and on changes over time. This work contributes to research in three big fields, namely psychological safety, team development, and group diversity by uncovering the dynamics of psychological safety and its relevance for team performance. All three research fields are of unabated interest for practitioners as well. I draw time related recommendations from our results in line with present team development and intervention theories (Gersick, 1988; Hackman & Wageman, 2005) how to enhance the development of psychological safety and discuss its limitations.

5 Study 1 – About the Buffering Effect of Subgroup Belonging on the Relation Between Task Conflict and Psychological Safety

Title: We Belong Together: Belonging to the Principal's In-Group Protects Teachers from the Negative Effects of Task Conflict on Psychological Safety

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Abstract

Psychological safety describes a trusting and accepting team atmosphere, where team members feel free to address critical issues. Critical team events such as conflict and faultlines (hypothetical lines that split a team into subgroups) should impact psychological safety. Previous research has shown the benefits of task conflict on team outcomes under certain conditions and the consistently negative effects of demographic faultline strength on individual or team outcomes. We propose that being close to the principal (in what we call belonging to the principal's in-group) should help reaping the benefits of task conflict and attenuate the negative effects of faultlines among teachers, because it is associated with a more effective working relationship.

In a survey study with 244 teachers from 45 primary schools, we tested the moderating effect of belonging to the principal's in-group vs. belonging to an out-group on the relationships of conflict and faultlines on psychological safety among teachers. Results of multilevel model tests showed that relationship conflict (but not task conflict) and faultlines decreased psychological safety. However, when teachers belonged to the principal's in-group as compared to an out-group, task conflict had no negative effect on psychological safety. We present implications to bridge in-groups and out-groups, so that psychological safety can become a resource for all.

Keywords: psychological safety, task conflict, principal's in-group and out-group, faultlines

5.1   Introduction

Teachers put themselves at risk in their everyday work with students, parents, colleagues, or higher institutions. They expose themselves to evaluations, rejections and criticism in their professional lives. As such, teachers who perceive their team as psychologically safe for interpersonal risk-taking have an important resource at work. Relationship and task conflicts, which can easily disembogue into personal assaults, are critical incidents that affect teachers' perceptions of psychological safety. Even though psychological safety is such a crucial phenomenon in teams, we know little about the inter-individual dynamics relating to psychological safety and how team processes and leadership jointly affect them (Edmondson & Lei, 2014; Newman, Donohue, & Eva, 2017). Recent research indicates that team members differ in their perceptions of psychological safety as subgroups emerge (Roussin, MacLean, & Rudolph, 2016; Schulte, Cohen, & Klein, 2012). Thus, our focus in this study lies on the inter-individual dynamics of teachers' perceptions of psychological safety, depending on relationship and task conflict in the past, the team's diversity (more precisely, the team's demographic faultline strength), and a teacher's proximity to the principal.

Three meta-analyses provide evidence that conflicts among team members, particularly if they are of a personal nature, negatively affect team outcomes, such as team performance (De Dreu & Weingart, 2003; De Wit, Greer, & Jehn, 2012; O'Neill, Allen, & Hastings, 2013). Yet, disagreements about the task can promote team performance under certain conditions (Bradley, et al., 2015). More specifically, three conditions can be considered for task conflict to become beneficial: if task complexity is high, if information processing capacity is available, and if conflict expression is possible in a constructive way, e.g. by open discussion norms, supporting team leadership, or inter-individual differences. Building on these previously found conditions, we put psychological safety perceptions front and center and focus on differences in the individual's perspective based on subgroup-belonging. Thus, we follow a contingency approach in understanding the complex interplay of task conflict and psychological safety perceptions by focusing on boundary conditions rather than on main effects (Bradley et al., 2015; De Wit et al., 2012).

We argue that conflicts are highly salient critical events that teachers refer to when evaluating their psychological safety in the team. As such, relationship conflict serves as a signal to individual team members as to how safe the team is for interpersonal risk taking. For task conflict however, we propose that close teachers and the principal could (intentionally or not) provide resources that help

reaping the benefits of task conflict on perceptions of psychological safety, if teachers belong to the principal's in-group. Furthermore, we propose that staff diversity, more precisely the team's demographic faultline strength, affects teachers' perceptions of psychological safety. A group faultline is a hypothetical line that divides a team into homogeneous subgroups along a set of the members' attributes (Lau & Murnighan, 1998). The stronger the demographic faultline is, the more the team members' perceptions of psychological safety will decrease because effective communication between subgroups is reduced (Lau & Murnighan, 2005). We also propose that this negative effect on perceptions of psychological safety can be attenuated when teachers belong to the principal's in-group compared to an out-group.

5.1.1   Psychological Safety

Psychological safety is defined as a belief that it is safe to take interpersonal risks in a team (Edmondson, 1999). Edmondson refers to interpersonal risks such as addressing problems, seeking help from team members, admitting own mistakes, or sharing crazy and wild ideas without being afraid of status or image losses. Psychological safety is understood as a specific team climate that invites team members to share contributions and exchange ideas, thereby building on trust and mutual respect (Edmondson, 2002). As such, psychological safety is subject to group dynamics and development processes. When studying psychological safety in innovation teams, Edmondson and Mogelof (2005) found high internal consistencies within individuals and differences between individuals, as well as agreements within teams and variances between teams. In a later review, Edmondson and Lei (2014) conclude that psychological safety can be investigated as individual experience (on an individual level), a belief shared by the members of a team (on a team level), or on a higher level (e.g., on an organizational level).

Several studies showed the relevance of psychological safety in educational, hospital, and organizational settings. Psychological safety has numerous positive outcomes, such as increased job engagement, job satisfaction, team learning and team performance (Callister, 2006; Edmondson, 1999; May, Gilson, & Harter, 2014; Schaubroeck, Lam, & Peng, 2011). Conflicts should serve members of a team as an important experience which influences their psychological safety, because they are critical incidents in teams. In this study, we focused on the potential benefits of task conflict because it is a crucial factor for a successful collaboration and a fruitful working environment. Thus, it is essential to identify boundary conditions under which task conflict can unfold its benefits for

work teams (Bradley et al., 2015).

5.1.2 Relationship and Task Conflict in Teams

Conflicts are inevitable, especially when members of a team work interdependently together over a longer period of time. The absence of conflicts in a work team is even considered a sign for unhealthiness and precarious stagnation (Levi, 2011). Conflict is defined as an incompatibility of goals and behaviors between two or more parties (Tedeschi, Schlenker, & Bonoma, 1973). Thus, conflicts arise when team members follow different goals, which can be communicated openly or can be kept silent (hidden agendas, Levi 2011). Intra-team conflict can further result from "the tension between team members because of real or perceived differences" (De Dreu & Weingart, 2003, p.741). This definition refers to the perception of diversity as a general cause of conflicts.

Because members provide both social and task input when working together, we take into consideration two types of conflict, namely relationship and task conflict (e.g., Jehn, 1995; De Dreu & Weingart, 2003). Relationship conflict refers to tensions regarding personal or political preferences, attitudes and values, or interpersonal beliefs and interaction styles. Task conflict refers to tensions regarding resources, judgments, work procedures, or the handling or understanding of facts (De Dreu & Weingart, 2003).

Meta-analyses consistently demonstrate the negative effects of relationship conflict on team outcomes (De Dreu & Weingart, 2003; De Wit et al., 2012; O'Neill et al., 2013). An increased arousal and cognitive load hinders team members to work efficiently together, because resources are reallocated from working on the task to coping with the conflict (Carnevale & Probst, 1998).

The effects of task conflict, however, are mixed, demonstrating a negative effect as well as no effects on team performance with large variances clearly indicating the presence of moderators (De Dreu & Weingart, 2003; De Wit et al., 2012; O'Neill et al., 2013). Thus, the effects of task conflict are best understood by following a contingency approach. Task conflict has less negative effects on team outcomes in the presence of certain factors or team situations, e.g., when relationship and task conflict are not highly correlated or when trust or psychological safety are high (De Dreu & Weingart, 2003). These teams can profit from task conflict because task-relevant information is elaborated in more depth, leading to a better decision quality. In a recent review, Bradley et al. (2015) develop three perspectives under which task conflict can be beneficial for work groups: task complexity, information processing, and conflict expression. In this third perspective, psychological

safety perceptions can be integrated as outcome because an open discussion that allows team members to express conflicting opinions directly, factually, and in a professional way should lead to positive effects of task conflict in terms of higher levels of psychological safety.

5.1.3   Empirical Findings on Conflict and Psychological Safety

In previous studies, researchers focused on psychological safety as a moderator for the relation between task conflict and team outcomes, or different factors relevant for team effectiveness, such as synergistic knowledge, learning activities, information sharing, and cognitive diversity expertise (Bradley et al., 2012; Bunderson & Boumgarden, 2010; Kostopoulos & Bozionelos, 2011; Martins et al., 2013; Mu & Gnyawali, 2003). All studies report a negative correlation between task conflict and perceptions of psychological safety, except for one: Martins et al. (2013) examined relationship conflict and psychological safety as moderators for the relation between different cognitive diversity effects on team performance. In this study, task conflict was positively associated with psychological safety ($r = .66$).

In summary, previous studies support a contingency approach in explaining the complex interplay of intra-team conflict and psychological safety. Our study adds to the research on contingency models by considering psychological safety as important team outcome and focusing on the boundary condition of belonging to a specific subgroup on the relation between task conflict and psychological safety.

5.1.4   Group Faultlines Impact Team Processes

Group faultlines are hypothetical lines that split a team in homogeneous subgroups along a set of demographic characteristics, such as gender, age, and tenure or other job relevant skills (Lau & Murnighan, 1998). The stronger the demographic faultline is, the worse team performance was found to be (Thatcher & Patel, 2012).

Demographic faultlines can form at any time during a teams' interaction. However, faultlines should affect the team from the very beginning of the collaboration, or with the entrance of new members (Lau & Murnighan, 1998, p. 332). Based on three theories, namely Self-Categorization Theory (Turner, 1982), Social Identity Theory (Tajfel, 1978) and the Similarity-Attraction Paradigm (Byrne, 1971), individuals find themselves belonging to homogeneous (sub-)groups. According to

the model of group faultlines (Lau & Murnighan, 2005), the formation of subgroups hinders effective collaboration by reducing team learning, psychological safety, satisfaction and expected team performance. When comparing strong-faultline teams with weak-faultline teams, researchers identified cross-subgroup communication as one particular factor for the success of teams with a weak faultline as it reduces intragroup conflict (Lau & Murnighan, 2005). Thus, the authors propose that in teams with a weak faultline, members rather identify with the entire team allowing the team to develop high levels of psychological safety compared to teams with a strong faultline, in which members identify stronger with the respective subgroup leading to a disruption in the overall perceptions of psychological safety. Thus, what could have been meant as constructive critique from members of other subgroups may be interpreted as an attack, stressing the subgroup boundaries similarly to an out-group effect (Lau & Murnighan, 2005).

In such a subgroup structure, leaders are pivotal. As such, members who belong to the subgroup that includes the leader profit from higher relationship quality and from an increased exchange of resources when compared to members of a subgroup that excludes the leader (Leader-Member-Exchange theory, LMX, Graen & Uhl-Bien, 1995; Meyer, Shemla, Li, & Wegge, 2015). Further, acts of asking questions, seeking feedback, or disclosing mistakes should be considered rather helpful than as a threat for members of the subgroup that includes the leader compared to members of the subgroup that excludes the leader.

5.1.5   Emergence of Subgroups: Leader In-Group and Out-Groups

Leaders and team members equally shape psychological safety (e.g. May et al., 2004). For instance, leaders who invite team members with words and deeds to bring in ideas can bridge status differences (Nembhard & Edmondson, 2006). Moreover, concrete leader behavior affects psychological safety and team performance (e.g., Schaubroeck et al., 2011). Likewise, close staff members (which could include the leader as well) shape perceptions of psychological safety through high-quality relationships, positive interactions and team norms (e.g., Carmeli & Gittell, 2009; Edmondson & Mogelof, 2005; May et al., 2004, Schulte et al., 2012). As such, it is often difficult to disentangle the impact of leaders and team members when it comes to the development of psychological safety (Edmondson & Mogelof, 2005). The existence of subgroups due to identity-based faultlines contributes to the explanation of the interplay of leader and member impact on the dynamics of psychological safety by expanding Leader-Member-Exchange theory to a subgroup

level (Meyer et al., 2015).

According to Leader-Member-Exchange theory, there is an individual dyadic relationship between the leader and each team member. The leader-member relationship is considered as interactive process between leader and followers (Graen & Uhl-Bien, 1995). The emergence of leader-related in-group and out-groups is grounded in the same theories as subgroup categorization from diversity research (e.g. faultline theory, Thatcher & Patel, 2012). Members who are similar to their leader are categorized into the same group (*in*-group) and seem to profit from a higher resource exchange and higher relationship quality, whereas members who are perceived as rather different are categorized into another group (*out*-group) and have lower relationship quality (Graen & Uhl-Bien, 1995). Recently, Meyer et al. (2015) expanded LMX theory from a dyadic to a subgroup perspective, referring to Carton and Cumming's (2012) theory of subgroups. In essence, members of the leader in-group profit from a higher exchange of resources due to their performance decreasing to a lesser extent in times of crisis when compared to members of the out-group.

Following this line of reasoning, we assume that members who belong to the leader in-group report stronger perceptions of psychological safety when compared to members of an out-group. The following finding supports this assumption. Burris et al. (2009) found that members belonging to an inner circle vs. an outer-circle of the leader felt more psychologically safe. Furthermore, if conflicts concerning work tasks occur frequently within the team, members of the leader in-group should again benefit from high relationship quality and a higher resource exchange. Thus, they should nevertheless feel safer to speak their minds when compared to members of a leader out-group. In summary, belonging to the leader's in-group should dampen the negative effects of task conflicts on psychological safety, because it is associated with a better understanding of problems and needs, more access to benefits, and a more effective working relationship (cf. Graen & Uhl-Bien, 1995).

Similar to conflicts, the extent to which a team is potentially split into homogenous subgroups, that is faultline strength, itself has a negative impact on team outcomes (Lau & Murnighan, 2005; Thatcher & Patel, 2012). Based on the model of faultlines, group members rather communicate and share information with members of the own subgroup than with members of other subgroups. Thus, faultline strength should have a negative effect on psychological safety in groups (Lau & Murnighan, 2005). Furthermore, faultline strength was found to moderate the relation between subgroup belonging and individual performance (Meyer et al., 2015). As such, in times of an organizational crisis, leader out-groups performed worse when the faultline was strong, compared to when the faultline was weak (Meyer et al., 2015). Therefore, faultlines could affect in-group and out-group members differently. Regarding psychological safety, belonging to the leader in-group

compared to an out-group could as well be associated higher levels of trust in the leader, and thus a higher willingness to take an interpersonal risk (Schaubroeck et al., 2011). Thus, we tested belonging to the leader in-group (vs. an out-group) as moderator for the relation between the faultline strength and psychological safety.

5.1.6   Goals of the Study and Hypotheses

In this study, we had two objectives: First, we broadened the understanding of psychological safety as a dynamic concept by viewing psychological safety as an outcome, and not as an antecedent for conflict. As such, relationship and task conflicts are critical events that determine the development of psychological safety. Second, we considered subgroup emergence due to identity-based faultlines, specifically belonging to the leader in-group or out-group, as an additional predictor for perceptions of psychological safety. Building on a contingency approach, we investigated if task conflict had different effects on psychological safety dependent on subgroup-belonging. Members of the subgroup that includes the principal should profit from their membership in terms of more psychological safety in the presence of high task conflict. Similarly, faultline strength had a consistent negative effect on team outcomes (Thatcher & Patel, 2012). Yet, team members who belonged to the subgroup that includes the leader were protected from the detrimental effects of their team's faultline strength (Meyer et al., 2015). We assume that faultline strength reduces teachers' perceptions of psychological safety. Yet, belonging to the principal's in-group should function as a protecting shield against this negative effect.

We therefore propose

Hypothesis 1: Demographic faultline strength is negatively associated with perceptions of psychological safety.

Hypothesis 2: Belonging to the principal in-group vs. belonging to an out-group is positively associated with perceptions of psychological safety. In-group members (including the principal) report higher psychological safety compared to out-group members.

Hypothesis 3: Belonging to the principal in-group (vs. out-group) buffers the negative effects of task conflict on psychological safety.

Hypothesis 4: Belonging to the principal in-group (vs. out-group) buffers the negative effect of demographic faultline strength on psychological safety.

5.2 Method

We conducted a cross-sectional correlational study in primary schools and asked teachers to assess their psychological safety as well as all other variables of interest via questionnaire. Prior to data collection, we obtained authorization by Saxony's Bildungsagentur, a state-level institution that administrates data collection at German schools. We encouraged schools to participate in a high number, with at least 50 % of members per school, in order to receive a representative set of data. As such, we took into account the multi-level structure of our data containing the matching assessments of principals and teachers on the shared perceptions of intra-team conflict and psychological safety.

5.2.1 Participants

In total, 244 participants (94.24 % female) from 45 primary schools in Saxony/ Germany responded to our survey, including 29 principals, 4 temporary principals, and 10 vice principals; 179 teachers, 9 educators and 3 student teachers. On average, the teachers were 46.82 years old ($SD = 10.00$, $Min = 23$, $Max = 65$) and had been working at their respective schools for 11.88 years ($SD = 9.84$, $Min = 1$ month, $Max = 40.5$ years). Schools had between 4 to 21 teaching staff members ($M = 10.16$, $SD = 4.73$). We received an average response rate of 58.69 % per school ($Min = 9$ %, $Max = 100$ %). For the analyses, those schools with only one teacher participating (response rate = 9 %) had to be excluded from the mixed model calculations because the relevant group-level variables could not be computed.

5.2.2 Procedure

The survey was part of a bigger project addressing "Challenges in the life of a teacher". We asked teachers to assess the frequency of conflicts (intra-team conflict) among teaching staff members over the previous four weeks, the work climate (psychological safety), and demographic data. In order to picture a more or less usual school day and typical intra-team conflicts at work, we only collected data for schooldays (no holiday, no time of demonstrations).

First, we called the schools' principals, explained the purpose of the study, and invited them to participate. If the principal's response was positive, we sent an official invitation letter with a

summary of the study's objectives, contact information and further information about the process. The survey was then handed out to the principals to be distributed to the teaching staff. Completed surveys were dropped into sealed study boxes. Teachers completed questionnaires voluntarily and anonymously. In exchange for their participation, we offered these schools feedback about their most frequent stressors during daily school life. If more than 50 % of teachers per school responded, we included a comparison between the respective school and all participants of our study.

5.2.3   Assessment and Operationalization of the Variables

All items were translated into German by the authors and were adapted to the school context by substituting the term *team or group* by *staff (= Kollegium* in German).

Psychological Safety. Psychological safety was assessed with the Team Psychological Safety Scale, containing seven items (Edmondson, 1999). An example item was "If you make a mistake on this teaching staff, it is often held against you" (reverse scored). The answer scale ranged from 1 (*not at all*) to 7 (*absolutely*). *Cronbach's alpha* was acceptable with .68.

Relationship and Task Conflict. Conflict among staff members was assessed with the Intragroup Conflict Scale (Jehn, 1995). The scale measures Relationship and Task Conflict with four items each. Example items are "How much tension is there among members in your staff?" for relationship conflict and "To what extent are there differences of opinion in your staff?" for task conflict. We excluded one task conflict item ("How often do people in your work group disagree about the work being done?"), because a pre-test revealed that teachers had difficulties transferring the translated item to the school context. The answer scale ranged from 1 (*never*) to 5 (*very often*). *Cronbach's alpha* was good with $\alpha_{\text{Relationship Conflict}} = .77$, $\alpha_{\text{Task Conflict}} = .82$.

Demographic Faultline Strength and the Identification of Principal's In-Groups and Out-Groups. We calculated the demographic faultline strength in schools by using the average silhouette width (ASW) cluster algorithm in R, as recommended by Meyer and Glenz (2013). The ASW measure ranges between -1 and 1. Values near 1 represent rather homogeneous subgroups, whereas values near 0 represent the most diverse subgroups, as no homogeneous subgroups exist. A negative faultline strength indicates a pattern of ill-formed subgroups, as in this case dissimilarity of members *within* a subgroup is higher than *between* members of this subgroup and members of other subgroups (Meyer et al., 2015). This was not the case in our study.

ASW categorizes members to subgroups in a stepwise way. First, each group member has his

or her own subgroup consisting of the individual only. Next, the members who are the most similar in regards to demographic characteristics are merged into subgroups of two and so on, until as many subgroup configurations are found as exist. The algorithm calculates for all possible subgroup configurations the so-called silhouette widths representing the fit of each member to his or her possible subgroups. The average ASW value thus describes the average fit of all group members to their subgroup (for a more detailed description, see Meyer et al., 2015). Thus, ASW applies well to staff with more than 10 members (Thatcher, Jehn, & Zanutto, 2003). Following the procedure described by Meyer et al. (2015), we calculated an identity-based faultline on the demographic characteristics of gender, age and tenure. Gender is relevant because female faculty members report significantly lower perceptions of psychological safety when compared to male faculty members (Callister, 2006). Age and tenure have a distinct meaning for personal and organizational identity building, especially if members enter the organization at the same time (for more details about the meaning of age and tenure for diversity research, see Meyer et al., 2015). In addition to the demographic faultline strength for each school, the output in R provides the number of subgroups, their sizes, as well as explicit identification of teachers to the respective subgroups.

On average, the ASW algorithm clustered 2.4 subgroups ($SD = .54$) per school in our study, with a mean subgroup size of 2.70 members ($SD = 1.63$, $Min = 1$, $Max = 7$). Next, we identified principal in- and out-groups. Teachers who belonged to the subgroup that included the principal were coded with 1, whereas teachers who belonged to a subgroup that excluded the principal were coded with 0. We assigned all participants (principals, vice principals, and teachers) to subgroups because all of them can be part of an in-group or out-group. If schools reported that the principal had been absent for a long time (e.g. for half a year), we included the vice-principal as temporary principal for subgroup identification. Because of constraints in ASW calculation (e.g. due to missing values in demographic data, or not enough teachers or no principal responding per school), the sample size dropped to 40 schools[3].

Control Variables. First, we controlled for status as control variable on the individual level, which indicates the teacher's formal power. Principals and temporary principals were coded as 1, whereas teachers without formal leader function were coded as 0.

Next, we controlled for demographic attributes, namely gender and age on an individual level

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[3] Because the ASW measure can only be calculated with a complete dataset, we substituted missing values for the variable age, if possible, as follows: If teachers did not report their age, however, they reported how long they had been working as a teacher in their lifetime (working time as teacher) *and* at the current school (tenure), we estimated average values for age from the statements of teachers with similar demographics.

and on a school level, because they constitute the basis for the faultline. As such, demographic attributes and faultline strength may be correlated and they have shown to separately affect group processes (Thatcher & Patel, 2012). Furthermore, gender was found to have an impact on perceptions of psychological safety on the individual level (Callister, 2006).

On the school level, we operationalized demographic diversity effects by including the Blau index (Blau, 1977) for gender diversity, and within-team standard deviations for age and tenure (as recommended by Meyer et al., 2015; Thatcher & Patel, 2012) in our multi-level models. Because of intercorrelations between tenure and age, we only included age (on level 1 and 2) to control for effects of the attributes that constitute the faultline because teachers rarely switch schools in Germany. Thus, age should be more meaningful in this set of data. Further, we did not control for the number of subgroups, as this is only interpretable in the presence of strong subgroups, which was only the case for 3 schools in our data. Thus, we tested the effects in a separate model with an additional dummy–coded variable for schools with a strong faultline (ASW > +1 *s.d.*). Because it did not contribute to our model and in the sense of a more parsimonious model, we did not include it as control variable in the reported mixed models.

We further controlled for staff size in the analyses, because group processes and the possibility of interactions among staff members differ in larger and smaller staffs.

Originally, we had a data set of 244 teachers in 45 schools. Because 1) conflict was not assessed in all questionnaires, 2) we handle missing values in demographic assessments, and 3) not in every school the principal participated, data were strongly reduced when calculating demographic faultline strength and when coding in- and out-groups.

5.3 Results

5.3.1 Agreement Between Staff Members

Our data was structured hierarchically as members are nested in schools: Intra-team conflict refers to tensions or differences among staff members. Thus, all teachers of the same school should report similar levels of conflict because they refer to the same kinds of conflict. To test agreements between staff members' perceptions of psychological safety and intragroup conflict, we calculated the intra-class correlation coefficient by means of the statistic software R (R Development Core

Team, 2012). *ICC(1)* values indicate the proportion of the variable's variance that can be explained by group membership, here by school membership. *ICC(2)* values indicate the reliability of the measurements within schools, i.e. agreement between staff members in the assessment of a variable (Bliese, 2000; Grawitch & Munz, 2004). As expected, *ICC* values for relationship and task conflict were high and significant: $ICC(1)_{\text{Relationship Conflict}} = .29$, $F(29,121) = 3.08$, $p < 0.001$; $ICC(1)_{\text{Task Conflict}} = .29$, $F(28,116) = 3.03$, $p < 0.001$. Thus, 29 % of the variance in the respective subscales of intra-team conflict could be explained by school membership. The *ICC(2)* values showed a satisfying reliability, with $ICC(2)_{\text{Relationship Conflict}} = .68$, and $ICC(2)_{\text{Task Conflict}} = .67$. Thus, we aggregated relationship conflict and task conflict on the school level. ICC values for psychological safety were relatively low in comparison and not significant, $ICC(1) = .07$, $ICC(2) = .29$. Thus, we treated psychological safety as an individual-level variable. Correlations between all variables are displayed in Table 5.

Table 5

Correlations Between all School-Level Variables

Variables	M	SD	1	2	3	4	5	6	7
1 Gender, Blau's index	.06	.13							
2 Age, s.d.	7.57	3.48	-.14						
3 Tenure, s.d.	7.81	3.80	-.49*	-.25					
4 Demographic faultline strength	.47	.18	-.18	.08	.15				
5 Staff size	10.16	4.73	.10	.13	-.11	.32*			
6 Relationship conflict	2.41	.37	.59*	-.22	-.29	-.28	-.04		
7 Task conflict	2.85	.58	.31	-.23	-.15	.03	.40*	.50*	
8 Psychological safety	5.09	.94	-.10	.15	-.00	-.11	-.37*	-.18	-.72*

Note. * $p < .05$, $N = 45$, except for demographic faultline strength $N = 40$, and intragroup conflict $N = 29$. For the purpose of examining intercorrelations, we aggregated psychological safety on the school level.

5.3.2 Multilevel Model Analyses Predicting Psychological Safety

We had two levels because staff members (level 1) were nested in schools (level 2). The level 1 outcome was psychological safety. We analyzed the hierarchical data with the lmne R package *Linear and Nonlinear Mixed Effects Models*, version 3.1-131 (Pinheiro, Bates, DebRov, Sarkar, & R Core Team, 2017) in R (R Development Core Team, 2012). We followed recommendations of Bliese (2009) and Bliese and Ployhart (2002) for multilevel modeling: First, we identified the random effects structure of our model by testing a focal predictor in a simple model adding random effects to this baseline model in a stepwise way. We compared the -2 Log-Likelihood index for selecting the best-fitting model. A random intercept, random slopes model had no better fit than a random intercept, fixed slopes model ($\Delta\chi^2$ (2) = .089, p = .9565). Thus, a random intercept, fixed slopes model fit the data best.

To begin, we calculated a null model with psychological safety as outcome to compare it in the following steps to more complex mixed models. Next, we added control variables, the main effects and the cross-level interaction to the baseline model step by step (Bliese, 2016; Bliese & Ployhart, 2002). All variables were added grand-mean centered except for the dichotomous level-1 variables gender, status (principal vs. no principal), and belonging to the principal's in-group or an out-group. We referred to the *Akaike Information Criterion* (AIC) and *Bayesian Information Criterion* (or Schwarz-Bayesian Criterion BIC, considering sample size), and the -2 Log Likelihood statistic as indices for model fit (see Garison, 2013). When comparing the tested models, lower AIC and BIC values indicate a better fit of the model. All tested models with the respective coefficients and model fit indices are presented in Table 6.

Model 1 contains the following control variables as predictors: Gender, age, and status on level 1, as well as staff diversity indices for gender (Blau index) and age, and staff size on level 2. None of the variables were significantly related to psychological safety.

Table 6

Results of Multilevel Model Analyses Predicting Psychological Safety

Parameter	Model 1	Model 2	Model 3	Model 4
	b (SE)	b (SE)	b (SE)	b (SE)
Fixed effects Level 1 (Teachers)				
Intercept	5.24 (.08)*	5.23 (1.06)*	5.23 (.15)*	5.22 (1.03)*
Gender	-.11 (.30)	-.14 (.62)	-.13 (.61)	-.16 (.61)
Age	-.01 (.01)	-.01 (.01)	-.01 (.01)	-.01 (.01)
Status	.11 (.18)	.16 (.31)	.20 (.31)	.21 (.31)
Belonging (in- vs. out-group)		.14 (.27)	.09 (.26)	.09 (.27)
Fixed Effects Level 2 (Schools)				
Gender, Blau's index	-.58 (.66)	-2.58 (1.60)	-2.66 (1.57)†	-2.79 (1.60)†
Age, s.d.	-.00 (.03)	-.04 (.05)	-.04 (.05)	-.04 (.05)
Staff size	-.02 (.02)	.03 (.04)	.04 (.04)	.04 (.04)
Demographic faultline strength		-3.55 (1.52)*	-3.95 (1.50)*	-4.44 (1.86)*
Relationship conflict		-.88 (.37)*	-.76 (.37)*	-.77 (.37)*
Task conflict		-.16 (.19)	-.55 (.26)*	-.54 (.26)*
Cross-level interaction				
Task conflict X Belonging			.62 (.29)*	.59 (.30)†
Demogr. faultline strength X Belonging				.94 (2.08)
Random Effect Variances				
Intercept Level 2	.08	.00	.00	.00
Residual	.8203	.8745	.8345	.8445
AIC	619.91	266.25	264.43	262.93
BIC	650.24	298.16	298.80	299.75
-2LL	602.6	240.2	236.4	233.0

Note. * $p < .05$, † $p < .1$, unstandardized coefficients are presented (with *SE*). All models are random intercept, fixed slopes models. Model 1 was compared to the null model, with $N = 215$ teachers on level 1, and $N_g = 40$ schools on level 2 for Model 1; and $N = 86$ teachers on level 1, and $N_g = 17$ schools on level 2 for Model 2, 3 and 4.

5.3.3 Conflict and Demographic Faultline Strength Predict Psychological Safety

In Model 2, we tested the proposed main effects by adding belonging to the principal's in-group (vs. out-group) as level 1 predictor, and relationship conflict, task conflict, and demographic faultline strength as level 2 predictors to the baseline model. Because findings on intragroup conflict demonstrate the interrelations between conflict types and demographic faultline strength, we tested these effects in one model at the same time (e.g., Thatcher & Patel, 2012). Results showed that relationship conflict and demographic faultline strength significantly predicted perceptions of psychological safety. The more relationship conflict and the stronger the demographic faultline was, the less psychologically safe teachers reported to be. However, belonging to the principal's in-group (vs. out-group) did not predict psychological safety. Thus, we found support for H1, but not for H2.

5.3.4 Testing for a Cross-Level Interaction: Belonging to the Principal In-Group or Out-Group as Moderator

In Models 3 and 4, we tested our moderation hypotheses: Belonging to the principal's in-group (vs. out-group) was assumed to moderate the relation between task conflict and psychological safety (Model 3), and the relation between demographic faultline strength and psychological safety (Model 4). We added the two respective interaction terms stepwise to the model and found a significant cross-level interaction which confirmed that principal in-group members, when compared to out-group members, showed different patterns of how perceptions of psychological safety were affected by task conflict. Thus, we found support for H3. The cross-level interaction between subgroup membership and demographic faultline strength was not significant, however. Thus, we did not find support for H4.

Figure 3 illustrates teachers' psychological safety depending on their subgroup membership and task conflict. We used the web tool provided by Preacher, Curran, and Bauer (2016) to test for simple slopes. For the principal in-group, simple slopes analyses showed no significant difference in psychological safety assessments under high or low task conflict conditions. For the out-group, however, the simple slope was significant, $\gamma = -.55$, $SE = .26$, $p = .04$.
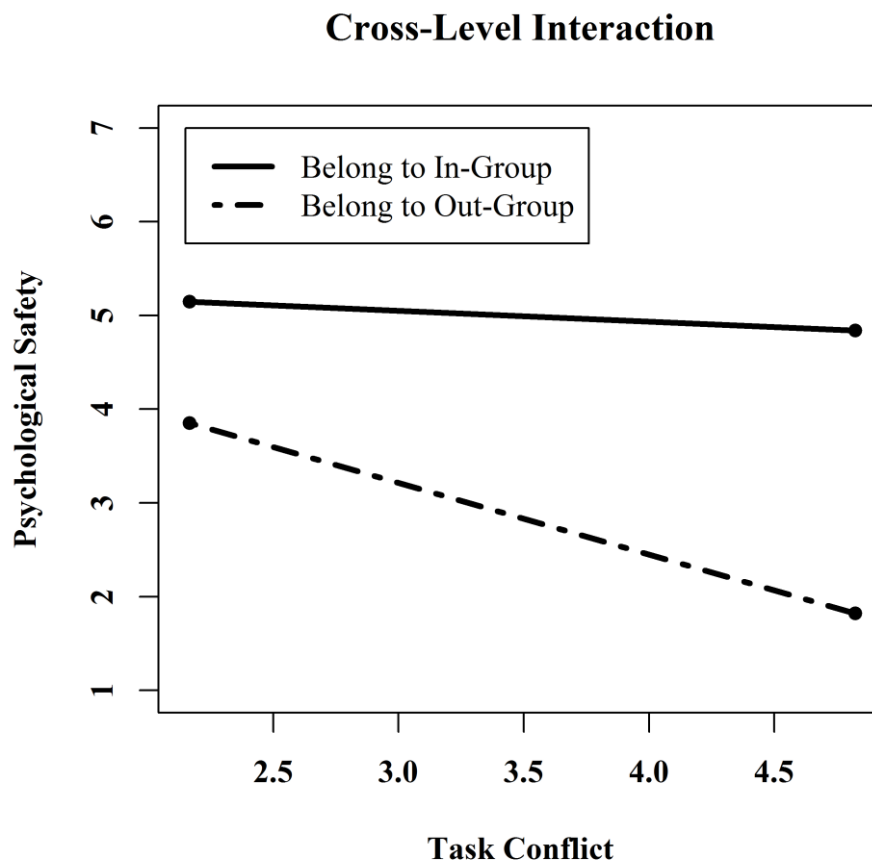
Figure 3. Illustration of the Cross-Level Interaction Between Belonging to the Principal In-Group (vs. an Out-Group) and Task Conflict Predicting Psychological Safety in Teaching Staff ($N = 86$ Teachers and $N_g = 17$ Schools). Task Conflict Ranges Within *Min* and *Max* Values.

These results illustrate that if teachers belonged to the principal in-group, task conflict had no (negative) effect on psychological safety perceptions. Whereas, if teachers belonged to the principal out-group, teachers assessed psychological safety more negatively in the presence of high task conflict.

In summary, we found that relationship conflict and demographic faultline strength negatively predicted psychological safety, whereas task conflict did not. However, task conflict negatively predicted psychological safety, when teachers did not belong to the subgroup including the principal. It seems as though belonging to the subgroup including the principal buffers against the negative effects of task conflict.

5.4 Discussion

We address the question of how teachers' perceptions of psychological safety are shaped

by critical events such as task conflict under certain conditions. Our study follows a contingency approach for the effects of conflict (Bradley et al., 2015) and contributes to research on important team outcomes, namely teachers' perceptions of psychological safety. Further, we add knowledge about psychological safety by referring to basic theories from social psychology and the latest consistent findings in the fields of diversity and leadership, theorizing on a subgroup level and testing effects of subgroup belonging.

First, we showed that task conflict has a buffering effect on teachers' perceptions of psychological safety under certain conditions. We identified subgroup belonging as one important boundary condition. Second, we adhered to scholarly calls in the field of diversity and psychological safety research by examining the dynamics of subgroups, more specifically subgroups that included and excluded the principal (Carton & Cummings, 2012; Meyer et al., 2015), to explain the joint impact of leader and team members' influence on inter-individual perceptions of psychological safety (Edmondson & Lei, 2014; Newman et al., 2017; Roussin et al., 2016). Third, we applied new methods (that is, the ASW cluster algorithm) to investigate the effects of demographic faultline strength and subgroup emergence on perceptions of psychological safety, thereby taking into account the multi-level structure of our data.

In this study, we focused on psychological safety as an outcome. We found that relationship conflict and demographic faultline strength negatively predicted teachers' perceptions of psychological safety. Based on these faultlines subgroups emerged. Belonging to the subgroup that included the principal (compared to subgroups that excluded the principal) did not predict psychological safety per se. Yet, principal in-group members were protected from the negative effect of frequent task conflict on psychological safety compared to out-group members.

Before discussing the limitations of our study, we would like to point out its strengths. First, we deepened the understanding of how task conflict predicts individual perceptions of psychological safety under certain conditions. We demonstrated that belonging to the principal's in-group can attenuate the negative effect of high task conflict on psychological safety for in-group members when compared to out-group members. Thus, frequent task conflicts could be a sign of healthy and constructive communication among members of the in-group. Neither did we assess the quality of relationships among group members, nor the constructive communication behavior in our study. Yet, some findings support our interpretation. As such, psychological safety mediates the relation between high-quality relationships at work and learning from failures (Carmeli & Gittell, 2009). Furthermore, subgroups that emerged due to friendship ties co-evolved with perceptions of psychological safety over time (Schulte et al., 2012). Considering the item level, psychological safety comprises a tone of respect and appreciation in the group, supporting the line of reasoning towards constructive communication, e.g. "In working with this team, my unique skills and talents are valued and utilized," "It is difficult to ask other members of this team

for help," (reverse scored) and "People on this team sometimes reject others for being different" (reverse scored, Edmondson, 1999).

In contrast, out-group-members reported lower levels of psychological safety in the presence of high task conflict, and slightly lower levels of psychological safety in the presence of low task conflict. Thus, low and high task conflict appear to pose a threat for members of the out-group although the main effect of subgroup belonging was not significant. This could be explained by a different understanding of task conflicts for in-group and out-group members (e.g. conflict as constructive vs. threatening).

Second, we demonstrated the relevance of demographic faultlines for the assessment of psychological safety perceptions. As such, a strong faultline indicating that the teaching staff is divided into a clear set of homogeneous subgroups leads to lower perceptions of psychological safety. This finding is consistent with findings from meta-analyses on the effect of team diversity and faultlines on team processes and performance (e.g., Thatcher & Patel, 2012) and with findings supporting the model of group faultlines (Lau & Murnighan, 2005). The model stresses different identification processes. More specifically, members of subgroups with a weak faultline rather identify with the whole group, whereas members of subgroups with a strong faultline rather identify with their own subgroup, tending to attribute acts of other subgroups' members as threatening, comparable to a general out-group effect (e.g., Sherif & Sherif, 1953).

Third, we changed perspective by theorizing on a subgroup level, as recommended by Meyer et al. (2015). We take LMX theory from a dyadic level to a subgroup level, thereby stressing the leader's position within the subgroup structure and her or his pivotal role for teachers' psychological safety perceptions. As such, we found that in-group members profit from their proximity to the principal in the presence of high task conflict. This result is in line with LMX theory (Graen & Uhl-Bien, 1995), considering a high-quality relationship as characteristic for members of the in-group and their respective principal. This membership provides a higher exchange of resources and therefore leads to a higher degree of freedom to speak up. In addition to the high-quality relationships, a boost in informal status due to the in-group membership could explain our results. The finding that individuals with higher status contribute their views and statements to a stronger extent (Nembhard & Edmondson, 2006) supports this interpretation.

Our study has some limitations such as the cross sectional design, the small sample of schools, and the data which consists of self-ratings. We followed recommendations to reduce common method bias beforehand (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Because we assessed intra-team conflict *in the past* and psychological safety at one measurement point – and can therefore not examine cause-effect-relations – we encourage researchers to address this question in a longitudinal design in the future. We recommend focusing on changes in teachers' perceptions of psychological safety within subgroups. By also assessing conflict and perceptions

of psychological safety via self- and other-ratings, one could gain more insight on how teaching staff members regard the presence of task conflict (own task conflict, task conflict within subgroups, or with the principal) and how it affects their perceptions and behavior at work.

Although psychological safety is a belief shared by staff members, members of specific subgroups differ in their assessments under certain conditions (e.g., in the presence of high vs. low task conflict) and depending on the proximity to the principal (e.g., belonging to the principal in-group vs. an out-group). Thus, implications should focus on a subgroup level and should address the group as whole and not just the principals.

5.4.1   Practical Implications

Our results demonstrate the importance for principals and teaching staff members to attain high-quality relationships with each other in order to attenuate the salience of out-group belonging due to identity-based demographic faultlines (Graen & Uhl-Bien, 1995; Schulte et al., 2012). Positive beliefs of diversity that are openly communicated (e.g. pointing out the benefits of task conflicts and different opinions) help in overcoming the negative effect of faultlines on the group as well (Shemla & Meyer, 2012). In the presence of task conflicts, it is advisable to keep in mind that members who are less similar to the leader (and close staff members of her/him) differ in their perceptions of psychological safety. Thus, to profit from the buffering effects of being close to the leader, we recommend starting at a common ground by providing room for professional exchange and by stressing the meaning of task conflicts for process improvement, better elaboration of information, and higher decision quality (e.g., Bradley et al., 2015; De Wit et al., 2012).

5.4.2   Conclusions

In conclusion, our study highlights the meaning of critical events, such as relationship and task conflict on teachers' perceptions of psychological safety. It models the complex interplay of both leader and close team members' impact on perceptions of psychological safety by considering subgroup belonging and demographic diversity for inter-individual perceptions of psychological safety. As such, belonging to the principal's in-group can protect teachers from the negative effects of task conflict on psychological safety. They might therefore be better able to use task conflict as a resource at work.

6   Study 2 – About the Effects of Time, Demographic Faultline Strength, and Deep–Level Group Diversity on the Development of Psychological Safety

Title: A Question of Time: Effects of Time, Demographic Faultline Strength, and Deep-Level Group Diversity on the Development of Psychological Safety

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Abstract

Group psychological safety is a shared belief among group members that it is safe to take interpersonal risks. It has numerous positive effects, such as increased group learning and performance. This study contributes to the development of a dynamic view on team perceptions of psychological safety by focusing on the development of psychological safety over time. We examined group faultlines (hypothetical lines that split a group into subgroups) and antecedents located in group members' diversity (in terms of attitude, skills, and personality) as important predictors for how psychological safety forms and changes in 61 research groups over the course of a five-months long project in self-managed groups.

Results of a multilevel growth curve model showed that psychological safety generally decreased from beginning to the end of the project. Initial levels depended on the demographic faultline strength and on group members' mean attitude towards teamwork. Changes depended on group members' mean skills and mean conscientiousness. We discuss theoretical implications for future research in this area and offer suggestions for strengthening psychological safety in groups.

Keywords: psychological safety, development, faultline strength, group diversity, growth curve modeling

6.1   Introduction

The increasing prevalence of job insecurity, required flexibility, and work dynamic environment in today's working world emphasizes the relevance of group psychological safety enabling work groups to keep pace with these changes. Members perceive their group as psychologically safe if they believe that interpersonal risks can be taken such as expressing critical ideas or sharing unconventional contributions in the group without being compromised (Edmondson, 1999). Although considerable theory and research link psychological safety with numerous organizational outcomes, the major part of these studies lack a dynamic perspective and design on psychological safety perceptions (for a review, see Edmondson & Lei, 2014; Newman, Donohue, & Eva, 2017). Yet, it is pivotal to gain knowledge on how psychological safety develops over time for several reasons.

First, perceptions of psychological safety evolve within relational networks and are therefore theoretically and empirically vulnerable to critical incidents or changes in the team's life cycle (Schulte, Cohen, & Klein, 2012). Thus, it is important to consider – if possible – a broader time interval when investigating psychological safety. For instance, one group experiences low psychological safety levels, increasing over time to a medium level of psychological safety, whereas another group starts with high initial levels, decreasing over time levelling off in medium perceptions of psychological safety. In a cross-sectional study, these teams would have a similar value of psychological safety. Yet, they could have different relationships with group performance or group communication because they come from different starting points. As such, relying on cross-sectional findings means overlooking important dynamics in the teams' history possibly biasing subsequent conclusions.

Second, psychological safety is a key variable – amongst three others – that underlies the dynamics of subgroup emergence from group diversity and group faultlines, so-called hypothetical lines that split a group into homogenous subgroups (Lau & Murnighan, 1998, 2005). Yet, it remains to be tested whether group faultlines impact the immediate formation of psychological safety (as suggested by the model of faultlines by Lau & Murnighan, 2005) and/or whether they cause changes in psychological safety over time. This is important, because if practitioners recommend to foster psychological safety in teams at any point in time, this could be in vain as group faultlines hindered the formation of psychological safety and therefore might thwart such efforts – if the timing is not considered in these interventions.

Third, there is evidence that the absence of psychological safety has detrimental effects on numerous outcomes, e.g. job satisfaction (individual level), group learning and

performance (team level), and creativity (organizational level, Baer & Frese, 2003; Edmondson, 1999; May, Gilson, & Harter, 2004). Thus, psychological safety perceptions have been linked to other important organizational behaviors at all levels of organizational interest. Therefore, organizations benefit from insights into the dynamics of psychological safety, understanding and managing antecedents that lead to low or high initial levels of psychological safety, or causing changes – particularly for cases of a decrease – of psychological safety over time.

The present study is designed to start such an investigation thereby focusing on self-managed research groups who completed a project in a set timeframe of five months. We tested the effects of time, group faultlines, and group diversity (in terms of attitude towards teamwork, task-specific skills, and personality) as predictors located in the group for initial levels and changes in psychological safety. For our theoretical model, we build on findings from trust research, the model of group faultlines (Lau & Murnighan, 2005), and the main broad categories of group diversity investigated in team diversity research as organizing framework presuming that differences between individuals regarding their attitudes, values, and personalities constitute the fundament for similarity-attraction processes (Harrison, Price, Gavin, & Florely, 2002). In addition, we considered the groups' skills as an important work-related antecedent for psychological safety. As such, a group's positive attitude towards teamwork fosters collaboration in work groups (Bell, 2007), whereas a group's task-specific skills represent a significant resource for team processes and performance (Innami, 1994; Norton, Ueltschy Murfield, & Baucus, 2012). For research on group dynamics, personality factors have been essential since the early beginning because they drive specific behavior and perceptions that are relevant for team performance (Barry & Stewart, 1997; Bell, 2007). Furthermore, time has been found to catalyze the influence of a group's personality on group processes such as team social integration and performance (Harrison et al., 2002).

To complete our study, we aimed to replicate the positive relation between psychological safety and group performance during the performance stage of group work – taken into consideration a cyclic feedback between the two.

We adhere to scholarly calls by focusing on psychological safety as an important outcome itself (Edmondson & Lei, 2014; Newman et al., 2017). More specifically, our study contributes to research on the dynamics of psychological safety as we broaden the understanding of how psychological safety develops in groups and how demographic faultline strength and deep level group diversity affect the development of psychological safety over time. Our findings allow conclusions in regards to how and when to intervene more effectively in order to support the development of psychological safety.

6.1.1   Psychological Safety in Groups – Definition, Important Outcomes, and Antecedents

Psychological safety in groups is a shared belief by members that the group "is safe for interpersonal risk taking" (Edmondson, 1999, p. 354). Interpersonal risk taking refers to learning behaviors such as addressing problems, seeking help from other group members, or admitting individual mistakes without fearing status or image losses (Edmondson, 1999, 2002).

Early research on psychological safety focused on errors in hospital settings and their management (Edmondson, 1996; Edmondson, Bohmer, & Pisano, 2001). In qualitative interviews, members of the same team reported similar perceptions about sharing sensitive information, such as admitting mistakes or reporting concerns about work procedures, to the group or their leaders. However, there were differences between teams: Some felt that they could learn from their mistakes by revealing them openly to each other; others felt rather intimidated by such behavior and were afraid of potential negative consequences. As such, it is conceptualized as "a team climate characterized by interpersonal trust and mutual respect in which people are comfortable being themselves" (Edmondson, 2002, p. 7). Thus, groups with high perceptions of psychological safety receive and give signals to each other, communicating that the group is welcome to share contributions and to exchange ideas.

Psychological safety in groups is associated with numerous outcomes, such as higher learning behavior, better innovation processes, and team performance, just to name a few (e.g., Choo, Linderman, & Schroeder, 2007; Edmondson, 1999; Schaubreock, Lam, & Peng, 2011).

Antecedents of psychological safety are friendship ties among group members, group norms, the quality of information exchanges, and group-oriented leadership behavior (Carmeli & Gittell, 2009; May et al., 2004; Schaubroeck et al., 2011; Schulte et al., 2012). Practitioners and researchers mostly focused in their implications on the group leader and less on what group members can do. By referring to the model of group faultlines (Lau & Murnighan, 2005), we shift our focus specifically on what group members bring into the group and how group diversity affects the formation and changes of psychological safety.

6.1.2   Hypotheses Development – Theoretical Considerations and Empirical Findings

6.1.2.1   The Effect of Time on Group Psychological Safety.

To implement psychological safety in groups, we must understand how psychological safety builds and develops in the first place.

Initial Levels. Most researchers agree on the idea that psychological safety needs time to unfold in groups, indicating an increase over time (Edmondson & Lei, 2014). The simple theoretical assumption behind is that perceptions of psychological safety start at a zero-level gradually increasing over time as group members become acquainted and build trust. To fill this handrail with more life, we refer to trust research when elaborating our descriptive expectations. At first, researchers had the same theoretical assumption for trust, a construct similar to psychological safety but not identical (for a theoretical differentiation, see Edmondson, 2002; Lewicki, Tomlinson, & Gillespie, 2006). However, findings indicated that individuals experienced a high level of trust even before interacting with one or more parties without having any interaction history before comparable to a leap of faith for the start of a productive teamwork (Lewicki et al., 2006). Subsequently, we would expect moderate to high initial levels of psychological safety.

Changes over Time. So far, two studies provided empirical evidence on the development of psychological safety. In a first study, perceptions of psychological safety remained stable over time (Edmondson & Mogelof, 2005), whereas findings of a second study indicate that team perceptions of psychological safety decrease over the course of collaboration (Schulte et al., 2012).

Edmondson and Mogelof (2005) found a stable pattern of psychological safety in creative teams from the beginning until the end of a project. Personality factors predicted psychological safety at two points in time over the course of the group work (Edmondson & Mogelof, 2005). As such, neuroticism negatively predicted psychological safety at midpoint and end of a project, whereas openness positively predicted psychological safety at the end of a project**.**

Schulte et al. (2012) examined networks of perceptions of psychological safety in consulting teams. They found that psychological safety coevolved with developing friendship ties. Overall, group perceptions of psychological safety slightly decreased over ten months of collaboration (no test of significance reported). Furthermore, individuals' perceptions varied over time as if subgroups of like-minded parties formed, initiating a decrease in the perception of overall psychological safety.

In sum, we know that psychological safety is a climate that builds on trust. Thus, it seems to build instantly revalidating these perceptions in the ongoing process. It is open to

the group's influence, which means it can be disrupted, e.g., by a type of crisis, conflict or transitions in the work phases. According to group development theories, transitions happen in the early beginnings of collaboration and around midpoint in teamwork (Chang, Bordia, & Duck, 2003; Gersick, 1988). Time is one important trigger for a transition (Gersick, 1988). Similarly to a midlife crisis, groups experienced time pressure as half of the time has passed and at the end of the project when the deadline came closer. Groups that needed to make decisions under time pressure tend to cut off discussions and strive for a closing – also known as need for closure (Pierro et al., 2003). Thus, it is plausible that group psychological safety – the belief that questions, controversial opinions, or discussion are welcomed by the group instead of being sanctioned – is negatively affected by time, simply because time runs out. However, because there is no common ground to build a hypothesis, we start this paper with the following

Research Question 1: How does time effect the development of psychological safety across the course of a collaboration?

According to Hackman and Wageman (2005), group members are sensitive to signals of psychological safety from the very beginning, even within the first minutes of interaction. Thus, it is important to identify antecedents that impact the formation of psychological safety.

6.1.2.2 Demographic Faultline Strength Predicts Initial Levels of Group Psychological Safety.

The model of group faultlines suggests that psychological safety – besides group learning, satisfaction, and performance expectations – is strongly influenced by group diversity, more specifically by strong faultlines (Lau & Murnighan, 2005). Group faultlines are hypothetical lines that split a group into homogeneous subgroups based on principles of similarity along a set of attributes (Lau & Murnighan, 1998). These subgroups contain members who are characterized by a unique interdependence amongst each other (Carton & Cummings, 2012). Reviews show that group diversity has an overall negative impact on team processes and outcomes, thereby stressing the importance of demographic faultlines as they allowed an integration of former inconsistent findings for the first time (e.g., Thatcher & Patel, 2012; van Knippenberg & Schippers, 2007). Aside from demographic faultline strength, the number of possible subgroups emerging from the faultline was identified as an important predictor for group performance as well (Meyer, Shemla, Li, & Wegge, 2015).

Theoretical Background on Effects of Group Diversity. The mechanisms behind the

proposed effects of surface-level and deep level diversity are based on the theories of social identity (Tajfel, 1978) and self-categorization (Turner, 1982). As such, group members use overt features such as demographic differences and relevant overt skills to classify themselves and others into categories or groups with which they can identify themselves. Harrison et al. (2002) argue that these theories are valid for both surface-level and deep-level diversity, and that the latter may even be more important for such categorization processes because group members will seek confirmation of their own attitudes, values, and beliefs from the group. Furthermore, the similarity-attraction paradigm (Byrne, 1971) postulates positive effects in homogeneous groups, such as greater cohesion and higher team performance, because perceiving our group members as similar to ourselves leads to higher attraction (and vice versa; Mannix & Neale, 2005). Thus, group members enjoy working in groups made up of members with similar psychological characteristics because they perceive the connection as easier and are more likely to find the validation and approval they seek (e.g., Swann, Stein-Seroussi, & Giesler, 1992).

Furthermore, group members assess each other instantly dependent on overt demographic attributes such as gender, age, tenure, and – if available – functional background (Lau & Murnighan, 1998, 2005). Within groups with a strong demographic faultline, subgroups will emerge based on surface-level diversity, undermining the overall groups' perception that the group is safe for interpersonal risk taking because group members rather communicate and share information with members of the same subgroup than with members from other subgroups (Lau & Murnighan, 2005). In sum, the authors argue that group faultlines impact group processes from the very beginning, because it is essential for members to find productive subgroups for a good set off. The model of group faultlines further suggests that in groups with strong faultlines, members identify strongly with the subgroup and not with the entire group disrupting communication processes severely. As such, questions or problems addressed by members of other subgroups (out-groups) are rather perceived as hostile than helpful (Lau & Murnighan, 2005). Thus, we propose the following

> *Hypothesis 1:* Demographic faultline strength predicts initial levels of psychological safety: The stronger the demografic faultline is, the lower groups assess their psychological safety to be.

Aside from group faultlines and demographic attributes, groups' deep level diversity affects group processes and performance (Bell, 2007; Harrison et al., 2002).

6.1.2.3 Deep Level Group Diversity Predict Initial Levels and Changes of Group Psychological Safety.

Psychological safety in particular is a belief that is taken for granted, shared in the group and shaped by active behavior of group members such as asking for help or providing unconventional ideas in order to solve problems (Edmondson, 2002; Edmondson & Mogelof, 2005). Specifically, we examined deep level group diversity regarding attitude towards teamwork and task-specific skills as two context-dependent variables, and personality factors as an enduring set of variables. We refer to the main broad categories of group diversity investigated in team diversity research as organizing framework, namely group members' attitudes, values, and personalities (Harrison et al., 2002). In addition, we considered the groups' skill as an important work-related antecedent for psychological safety because groups with high task-related skills and domain-related knowledge are more likely to provide information to share in the group and thus should foster group learning and psychological safety.

Regarding the hypotheses, we postulate our assumptions on group level by considering the mean value and standard deviation as two indices for deep level group diversity regarding the respective variable (Harrison et al., 2002).

Groups' Attitude Towards Teamwork Predicts Initial Levels of Psychological Safety. Attitude towards teamwork is defined as the readiness to work in a team, or to cooperate with other team members or teams (Gardner & Korth, 1998). It is positively associated with individual perceptions of psychological safety (Ulloa & Adams, 2004) and based on former experiences with group work (Krug, 1997). Per this definition, we consider attitude towards teamwork a state (and not a trait, e.g., preference for teamwork) that group members bring into the first meeting. Thus, it should affect initial levels in psychological safety over time due to new experiences during group work (with the specific group members) possibly shaping an attitude towards teamwork (with the specific group) in a new way. Group members with highly positive attitudes towards teamwork possess an advanced readiness for mutual exchange, and they share the belief that exchange is beneficial for group work in general. Furthermore, we expect that similarities between members' attitudes foster perceptions of psychological safety as well, because individuals prefer to work with other individuals who are similar to them.

Therefore, we propose the following

Hypothesis 2: The groups' attitude towards teamwork predicts initial levels of
                psychological safety: a) The higher the group's mean attitude is

towards teamwork, the higher the initial levels of psychological safety will be.

b) The more similar group members' attitude is towards teamwork, the higher the initial levels of psychological safety will be.

Groups' Task-Specific Skills and Personality Predict Changes of Psychological Safety. In order to address upcoming problems, group members need to have the relevant skills to detect task-relevant information in the first place. Task-specific skills are an important team resource for group performance and impact how group members communicate and make decisions (Innami, 1994). Thus, context-dependent, task-related skills should be important to create psychological safety. In contrast to attitude towards teamwork, task-specific skills should be more important for changes in psychological safety over time (e.g. to correct mistakes later during work progress and to initiate new psychological safety assessments) than at the beginning. Firstly, these competences can only be assessed during the course of the work progress and not from the very beginning. Secondly, as the project comes to a close, time pressure may foster the importance of detecting group members' task-relevant competencies in order to successfully finish the project. As such, groups with high task-specific skills might be more in the position to detect problems and elaborate them in more depth as proposed by the categorization-elaboration model of group diversity (van Knippenberg, De Dreu, & Homan, 2004) enabling higher group learning and psychological safety. Furthermore, domain competent group members are more likely to be addressed when questions arise (Norton et al., 2012). Therefore, it is also plausible that groups' diversity in task-specific skills foster information exchange and thus psychological safety. Thus, we propose the following

Hypothesis 3: Groups' task-specific skills predict changes in psychological safety:

a) The more task-specific skills a group has, the more psychological safety will increase over time.

b) The more diverse a group's task-specific skills are, the more psychological safety will increase over time.

Finally, behavior and cognitions are driven by *personality factors* (Barry & Stewart, 1997). The most popular classification system regarding personality are the Big Five: Extraversion, openness to new experiences, conscientiousness, neuroticism, and agreeableness (Goldberg, 1993). So far, relatively stable replications of the Big Five dimensions with their respective associated characteristics have been found (Barrick & Mount, 1991): Individuals scoring high on extraversion tend to be social, talkative, gregarious, and assertive. Individuals high in openness to new experiences tend to be imaginative, curious, originally, and open-minded. Individuals high in conscientiousness

tend to be thorough, cautious, responsible, and organized. Individuals high in neuroticism tend to be anxious, depressive, angry, irritated, and worried. And finally, individuals high in agreeableness tend to be flexible, trustworthy, cooperative, friendly, and harmony-liking.

Groups with members scoring high on extraversion should foster mutual exchange, because group members are talkative and interested in social exchange. Further, extraverted individuals behave in group situations with more self-esteem expecting less social rejection (see theory of sociometer, Anthony, Wood, & Holmes, 2007). Groups of greater conscientiousness should foster mutual exchange about the task, because members are thorough and interested in correcting mistakes. Groups of greater openness for experience should foster the discussion of problems by inviting members to think outside of the box, or by offering unconventional ideas. The concepts openness and psychological safety show a clear conceptual overlap, and thus should be related with each other. Groups of greater neuroticism should experience less psychological safety, because members would behave rather passively and anxiously, which would hinder active exchange within the group. Finally, groups of greater agreeableness should foster exchange of personal and sensitive information, because their members signal trust and harmony to the group which will become more important over time that group members' are welcome in the group, anyway. The combination of group members' personality characteristics is important for team processes and outcomes, especially in relation to self-managed teams where group members' roles, which are rather unclear at the beginning, emerge and transform over time (Barry & Stewart, 1997). First findings confirm that individual experiences of psychological safety are influenced by personality factors at two points in time over the course of the group work (Edmondson & Mogelof, 2005). As such, neuroticism negatively predicted psychological safety at midpoint and end of a project, whereas openness positively predicted psychological safety at the end of a project. However, extraversion did not predict psychological safety at one of the later points in time during the collaboration. Effects of group diversity regarding personality factors have been shown to emerge later in the course of collaboration (Harrison et al., 2002), thus we assume that personality factors on a team level can predict changes in psychological safety. We are the first to test for diversity effects of team personality on perceptions of psychological safety. We refer to our theoretical elaboration and to Edmondson and Mogelof's (2005) investigation on how personality could impact perceptions of psychological safety. Therefore we include all Big Five dimensions in proposing the following

> *Hypothesis 4*: Mean team personality predicts changes in psychological safety. The higher a group's mean is in a) extraversion, b) openness to new experiences, c) conscientiousness, and d) agreeableness, the more

psychological safety will increase over time. The higher a group's mean is in e) neuroticism, the more psychological safety will decrease over time.

Group members' similarity or deviation regarding the Big Five might affect psychological safety perceptions over time differently. Because we assume a theoretically important relationship of some of these variables, and others are important control variables, we follow Becker's (2005) recommendations by including them in our theoretical hypothesizing. As such, a group composed of similarly high agreeable persons might experience a decrease in psychological safety perceptions over time, because nobody likes to challenge the groups' need for harmony. Furthermore, a group composed of similarly high neurotics might experience a decrease of psychological safety perceptions over time, because nobody has the courage to address problems that occurred. Thus, we tested and controlled for effects of groups' deviation regarding their team personality on psychological safety perceptions over time by proposing

Hypothesis 5: Diversity in team personality predicts changes in psychological safety. The more similar groups are in a) extraversion, b) openness to new experiences, and c) conscientiousness, the more psychological safety will increase over time. The higher groups are in d) agreeableness and e) neuroticism, the more psychological safety will decrease over time.

6.1.2.4   Psychological Safety is Related to Group Performance.

Finally, we aim to replicate the findings from numerous studies that show that psychological safety is positively associated with group performance (e.g., Bradley et al. 2012; Edmondson, 1999; Mu & Gnyawali, 2003; Schaubreock et al., 2011). We understand both psychological safety and group performance as dynamic processes. Therefore, we analyze the relation between the two variables at three time-sensitive points within group development (e.g., Chang et al., 2005; Gersick, 1988). As such, we consider relations at the beginning (when group members get to know each other and divide tasks amongst each other), at midpoint (a possible strategic turning point), and at the end (when group members concentrate their efforts).

We expect psychological safety to be related to group performance at all points: At the beginning, high psychological safety fosters the exchange of information and creative ideas in order to develop goals and to divide tasks for the project. At midpoint, high

psychological safety allows for critical considerations for the realization of the work project or for a change of tactics. At the end, high psychological safety enables reflection of the work process, appreciation of what went well and constructive feedback on what did not go so well. In former studies, psychological safety was both positively associated with self-rated group performance (e.g., Edmondson, 1999; Mu & Gnyawali, 2003) and other-rated group performance after the project was finished (e.g., Bradley et al., 2012; Schaubreock et al., 2011). Thus, we propose the following

> *Hypothesis 6*: Psychological safety is positively associated with self-rated and other-rated group performance at three time-sensitive points during collaboration of a project: The higher the group members assess their psychological safety to be at the beginning, at midpoint, and at the end of a project, the higher they rate their group performance to be at the respective time points.

We used multi-level based linear growth curve modeling (LGCM) to test our hypotheses regarding the development of psychological safety (Bliese, 2016; Gałecki & Burzykowski, 2013). Linear growth curve analysis is used in several psychological disciplines in order to investigate developmental trajectories, e.g. those of personality development or the impact of time for the development of social behavior (Jung & Wickrama, 2008). This method allows us to study the development of psychological safety in form of overall increase or decrease by modeling initial levels (the intercept) and changes within groups (interaction with time). This way, we can examine differences within and between groups over time and we can test our assumptions how faultline strength and group diversity predict initial levels and changes in group perceptions of psychological safety.

6.2   Method

6.2.1   Participants

Our study was part of a bigger research project about Time and Changes in Teams at Technische Universität Chemnitz. Sixty-one[4] groups of two to five members each participated in this study[5]. They worked on a university research project, which was part of

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[4] We excluded one group consisting of four members from further calculations because the group's assessment of psychological safety was an outlier having strong impact on our calculations.

[5] Any research material or data can be accessed via email from the 1st author.

their curriculum, over the course of five months. In total, 236 students from a German university participated in this study. Of these students, 67.80 % were psychology students and 31.78 % were students of cognitive sciences (a combination of physics and psychology). Data was collected over a period of three semesters. The majority of the participants were female (77.12 %) who were in their second year of study. Participants were between 19 and 44 years of age ($M = 22.34$, $SD = 3.43$).

6.2.2   Team Task and Recruitment of Participants

In their second year of study, psychology and cognitive science students needed to complete a course in experimental research. Their task was to design and conduct their own research project: They developed hypotheses, recruited participants, collected data, ran analyses, and critically discussed their results. Especially in the context of such a learning task, where group members are highly motivated to work together and to make good decisions from the very beginning, we believe that the development of psychological safety should be well observable (e.g., Mu & Gnyawali, 2003).

Students were able to state their preference for one of eight research topics (e.g., moral emotions, perceived trustworthiness of web pages), and be assigned to topics in accordance to their time of registration. After the first meeting, when supervisors explained the general demands of the course, we invited students to participate in our study. At this time, some groups had already formed on a voluntary basis. We briefly described the goal of our study and explained how data would be collected. In exchange for every complete questionnaire, the students received research credit points. In addition, groups could win a cinema coupon in a lottery to celebrate their project accomplishment. All of the 62 groups who were invited to the study participated.

6.2.3   Design and Procedure

The longitudinal design makes it possible to study temporal dynamics in groups. We asked group members to complete a questionnaire at three for the group development sensitive points in time, namely at the beginning, at midpoint, and at the end of the project (see Chang et al., 2005; Gersick, 1988). This way, we were able to investigate the early beginnings of psychological safety, as well as possible changes over midpoint to the end, when final decisions were made and the completion of the task was in sight.

We further related our measurement points to the following tasks that groups had to

fulfill during their course: at the first point of measurement, groups presented the theoretical framework for their projects (approximately four weeks following the start). We assumed that group members required this time to become connected before psychological safety and group performance could be adequately assessed. At the second point of measurement, groups presented their methods (by this time half of the project time had passed). At the third point of measurement, groups presented and discussed their results (at end of the project, just prior to their final presentations). Data was assessed anonymously. Group diversity variables were assessed at the first measurement. Group members assessed their psychological safety and self-rated group performance at all three points of measurement. The questionnaire included additional measures (e.g., leader behavior of individual group members), which were not analyzed in this study. At a fourth measurement point (approximately four weeks after conclusion of the projects, so that supervisors had time to evaluate the groups' scientific reports), we asked supervisors to rate the performances of their groups.

6.2.4   Measures

All scales had the same response format: On a Likert-type scale, group members rated the extent to which they agreed with the statements, ranging from 1 (*not at all*) to 7 (*absolutely*).

Group Psychological Safety. We assessed psychological safety in groups with the Team Psychological Safety Scale[6] (Edmondson, 1999). For the context of our study, we translated the scale into German and changed the term "team" to "group". Example items are "If you make a mistake on this group, it is often held against you" (reverse scored), and "Members of this group are able to bring up problems and tough issues". We translated the scale into German, remaining as close to the original expressions as possible (six items, $\text{alpha}_{\text{Beginning}} = .59$, $\text{alpha}_{\text{Midpoint}} = .76$, and $\text{alpha}_{\text{End}} = .71$).

Demographic Faultline Strength. We calculated the demographic faultline strength using the average silhouette width (ASW) cluster algorithm in R (Meyer & Glenz, 2013). The surface-level faultline included the demographic characteristics gender, age, course of study (psychology vs. cognitive science), and semester term (third, fourth, or fifth semester).

The ASW measure ranges between -1 and 1. Values near 1 represent the emergence

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[6] After the first point of measurement, several group members reported having difficulties in comprehending the fourth item "it is safe to take a risk on this group". We excluded this item so that six items were included in our calculations.

of mostly homogeneous subgroups, whereas values near 0 represent mostly diverse subgroups as no homogeneous subgroups exist. ASW categorizes members to subgroups in a step-wise approach. First, each group member has his or her own subgroup, consisting of him or herself only. Next, the members with the most similarities are merged into a subgroup of two, et cetera, until as all existing subgroup possibilities are calculated. Next, the mean ASW-value is computed for each team member representing how well he/she fits into the subgroup. In addition to the ASW-value for each group, the output in R provides the number of subgroups, the subgroup size, and an explicit identification of members to the subgroup (see Meyer, et al., 2015). In most groups ($n = 52$), only two homogeneous groups emerged, whereas three subgroups emerged out of the remaining nine groups. Subgroup size was on average 2.2 members per subgroup.

Attitude towards Teamwork. We assessed group members' general attitude towards teamwork with two items from the scale Free Rider, which is part of an instrument developed by Pfaff and Huddleston (2003) used to measure general and specific attitudes towards teamwork in student samples and used in a study investigating psychological safety and effective teaming (Ulloa & Adams, 2004). We translated the items into German. An example item is "I dislike teamwork because there are always people who do not do their share" (reverse scored). Correlation between the two items was -.65.

Task-Specific Skills. We assessed group members' skills in statistics and methodology due to group members requiring statistical and methodological knowledge for all steps of their empirical research project. For example, when reading the introductory articles, they needed to understand what had been done before and how. When planning the experiment, basic methodological knowledge helped with the selection of the design and the appropriate measures. In addition, when analyzing data, statistical knowledge is essential for testing hypotheses. Because students needed to successfully pass courses in statistics prior to participating in this group research project, we assumed that they would be able to properly answer the questions about their statistic skills.

To assess group members' task-specific skills, we adapted a German version of the Academic Self Description Questionnaire (ASDQ; Marsh et al., 2005b) to the context of these groups. In general, the ASDQ measures self-assessed skills in school subjects with six items each (e.g., in math, language, or sports). We replaced the school subjects with statistics and methodology. An example item is "In comparison to my fellow students, I am very good at statistics and methodology" (alpha = .90). ASDQ assessments correlated moderately with the respective grades (e.g., Marsh et al., 2005a).

The Big Five. We used the Big Five Inventory-25 to measure the personality dimensions of extraversion, openness to experience, conscientiousness, neuroticism, and

agreeableness, with five items each. The Inventory is a shorter version of the 44-item long Big Five Inventory by John, Donahue, and Kentle (1991), which was translated into German and validated by Rammstedt, Koch, Borg, and Reitz (2004). Example items are "I see myself as someone who is talkative" for extraversion (alpha in this study = .89), "… inventive" for openness to experience (alpha = .84), "… tends to be disorganized" (inverted item) for conscientiousness (alpha = .82), "… worries a lot" for neuroticism (alpha = .83), and "… generally trusting" for agreeableness (alpha = .67).

Group Performance. We assessed group performance through self-ratings at all points of measurement, and by supervisor ratings following project completion. Group members rated their performances on six items of the Team Evaluation Form (Lent, 2002, used in Lent, Schmidt, & Schmidt, 2006). Example items are "we meet our deadlines" and "our meetings are productive". We used three additional items of the Team Performance Scale (Lam, Schaubroeck, & Brown, 2004), e.g., "our group is competent" and "we effectively accomplish our tasks". We translated all items into German and conducted a principal component analysis. All nine items loaded clearly on one component with $alpha_{Beginning}$ = .88, $alpha_{Midpoint}$ = .90, and $alpha_{End}$ = .88. Supervisors rated the same items, except for "this group's meetings are productive", due to supervisors not having been present at the group meetings and therefore not being in a position to evaluate this item correctly (alpha for eight items = .93).

Control Variables. Demographic attributes may affect the group outcome above and beyond faultline strength. Thus, it is the best practice to include these controls (on individual level and group level) with respect to the tested hypotheses when conducting diversity research in order to maintain a more accurate picture of the tested effects of group dynamics (see Meyer et al., 2015). We operationalized demographic diversity effects on a group level by including the Blau index (Blau, 1977) for gender diversity, and course study, which was an index for group members' functional background. We used the deviation within the groups as an index for group diversity for age and semester term as an index for tenure (see Harrison et al., 2002). In addition to the mean group values of deep level diversity variables, we used the deviation within the groups as an index for group diversity for attitude towards teamwork, task-specific skills, and team personality (see Harrison et al., 2002).

6.3   Results

6.3.1   Data Preparation, Agreement Between Group Members and Data Aggregation

In a first step, we plotted trajectories of psychological safety of all groups (see Figure 4) and calculated agreements between group members in order to test for the nested structure of our data (Bliese, 2016). Thus, we calculated intraclass correlation coefficients *ICC(1)* and *ICC(2)*. The *ICC(1)* value indicates the amount of variance that can be explained by group membership. The *ICC(2)* value indicates the extent to which the group's mean rating is reliable, thereby taking the average group size into account (Bliese, 2000; Grawitch & Munz, 2004).

As expected and displayed in Table 7, we found high and significant *ICC* values for psychological safety, indicating high agreements within groups, yet differences between groups. In comparison, we found nonsignificant *ICC* values for personality traits and individual-level variables such as task-specific skills, indicating differences among group members, except for the personality dimension conscientiousness. Because we were interested in how group diversity variables, and not individual characteristics, affect initial assessments and changes of psychological safety, we aggregated all variables to the group level for correlation examination and hypothesis testing.
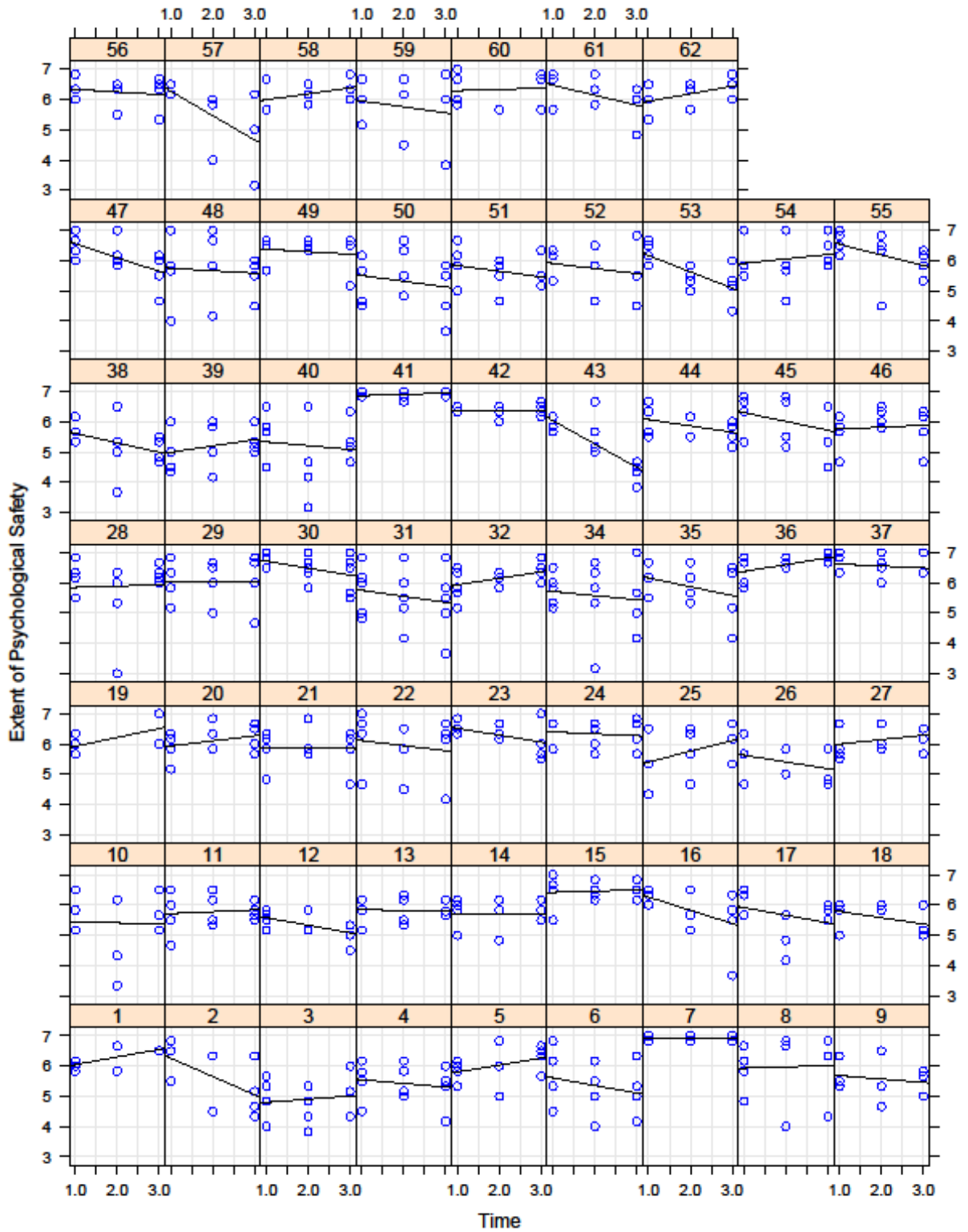
Figure 4. Trajectories of Psychological Safety Assessments of in Total 61 Groups (Note that Group 33 Was Excluded).

Table 7

ICCs of Psychological Safety in Groups, Self-Rated Group Performance, and Deep Level Group Diversity Variables Attitude Towards Teamwork, Task-Specific Skills, and the Big Five

Measure	Number of items	ICC(1)			ICC(2)		
		Beginning	Midpoint	End	Beginning	Midpoint	End
Group psychological safety	6	.18*	.14*	.26*	.46	.37	.58
Self-rated group performance	9	.19*	.22*	.31*	.47	.51	.63
Attitude towards teamwork	2	.06			.18		
Task-specific skills	6	.08			.25		
Big Five							
Extraversion	5	.02			.09		
Openness to experiences	5	.02			.09		
Conscientiousness	5	.12*			.35		
Neuroticism	5	0			.02		
Agreeableness	5	.05			.22		

Note. * $p < .05$, $N = 236$ group members in $N = 61$ groups.

6.3.2 Correlations Between Demographic Faultline Strength, Group Diversity Variables, Psychological Safety, and Group Performance

First, we analyzed correlations between demographic faultline strength, group diversity variables, group psychological safety, and group performance on group level (Table 8).

Demographic faultline strength was marginally significantly associated with psychological safety at all measurement points: The stronger the demographic faultline was, the lower groups assessed their psychological safety to be at all time points. Groups' mean and diversity regarding their attitude towards teamwork was significantly related with psychological safety in groups at all measurement points: The more positive, and the more homogenous group members' attitudes were towards working in a group, the higher groups assessed psychological safety at the beginning, at midpoint, and at the end. Task-specific skills were marginally significantly associated with psychological safety at the third measurement. The higher groups assessed their skills to be, the lower they assessed psychological safety at the end.

Table 8

Means, Standard Deviations, and Correlations Among Variables at Group Level at all Measurement Points

Variable	M	SD	1.1	1.2	1.3	1.4	1.5	1.6a	1.6b	1.6c	1.6d	1.6e	1.7	1.8	1.9	1.10	1.11	1.12	1.13a	1.13b	1.13c	1.13d	1.13e	1.14	1.15
Beginning																									
Controls and Mean Values																									
1.1 Group size	3.87	.53																							
1.2 Demographic faultline strength	.51	.18	.41*																						
1.3 Number of subgroups	2.15	.36	.19	-.23																					
1.4 Attitude towards teamwork, mean	4.87	.77	-.04	.07†	-.16																				
1.5 Task-specific skills, mean	4.43	.74	-.03	-.19	.07	.06																			
1.6a Extraversion, mean	4.57	.68	.25†	.09	.05	.00	.16																		
1.6b Openness to experiences, mean	5.30	.50	.05	-.05	.05	.15	.01	.11																	
1.6c Conscientiousness, mean	5.31	.66	.08	.17	-.25†	-.24†	-.15	.12	-.10																
1.6d Neuroticism, mean	4.29	.61	-.03	.02	.03	-.08	-.02	-.22†	-.39*	.18															
1.6e Agreeableness, mean	5.70	.39	.00	.04	-.02	.09	-.14	.08	.15	.34*	.05														
Surface-Level Diversity																									
1.7 Gender, Blau's index	0.21	.27	-.13	-.22†	-.07	.27*	.27*	.01	.07	-.49*	-.24†	-.18													
1.8 Age, s.d.	2.38	2.20	-.05	.10	-.17	.22†	-.20	-.20	.07	.13	.10	.20	-.17												
1.9 Study course, Blau's Index	.12	.25	.22†	-.18	.17	-.07	.19	.04	.09	-.07	-.08	-.14	.20	-.16											
1.10 Semester Term, s.d.	.28	.65	-.20	.14	-.18	.29*	-.11	-.32*	.08	-.09	-.13	.16	.26*	.51*	-.07										
Deep Level Diversity																									
1.11 Attitude towards teamwork, s.d.	1.26	.53	.10	.07	.01	-.59	.04	.05	-.09	.01	.06	.09	-.06	-.26†	-.04	-.29*									
1.12 Task-specific skills, s.d.	1.13	.47	.25†	.30*	.06	-.10	-.14	-.06	.21	.19	-.08	.02	-.17	.13	.10	.08	.10								
1.13a Extraversion, s.d.	1.23	.52	.21	.00	.09	.02	-.02	-.03	.02	.08	.03	-.13	-.03	.01	.09	-.07	.14	.14							
1.13b Openness to experiences, s.d.	.93	.46	.11	.05	.14	-.09	.02	.25†	-.45*	.06	.06	-.15	-.07	-.18	.12	-.14	.12	.11	.14						
1.13c Conscientiousness, s.d.	.91	.42	.33*	.21	.09	-.09	-.04	-.01	.02	.05	.21	.09	.04	.15	.19	.23†	-.05	.34*	.15	.05					
1.13d Neuroticism, s.d.	1.08	.50	.10	.12	-.25†	.12	.08	.13	.02	-.06	.04	.00	.23†	-.12	.00	-.22†	.17	.02	.07	.04	.12				
1.13e Agreeableness, s.d.	.77	.30	.00	.14	.11	-.23†	.08	-.08	-.04	-.07	.13	-.30*	.05	.05	.11	.05	.14	.30*	-.13	.05	.27*	-.10			
1.14 Psychological safety	6.01	.41	-.14	-.26†	.14	.30*	-.03	.10	.20	.13	-.17	.19	.01	.13	.07	.08	-.39*	.05	.02	-.09	-.20	-.32*	.06		
1.15 Group performance (self-rated)	5.92	.50	.08	-.12	.02	.12	-.19	.16	.05	.47*	.05	.24†	-.33*	.22†	-.04	-.12	-.20	.08	-.04	-.03	-.11	-.20	-.13	.47*	
Midpoint																									
2.1 Psychological safety	5.85	.52	-.16	-.22†	.01	.31*	-.05	.18	.06	.09	-.06	.06	-.03	.09	.14	-.06	-.29*	.01	-.02	-.01	-.13	-.24†	.01	.58*	.52*
2.2 Group performance (self-rated)	5.83	.57	.02	-.16	-.01	.05	-.14	.22†	-.06	.51*	.17	.19	-.36*	.03	-.02	-.34*	-.14	.07	.02	.12	-.09	-.09	-.18	.31*	.87*
End																									
3.1 Psychological safety	5.81	.56	-.09	-.22†	-.10	.35*	-.26†	.09	.13	.29*	-.04	.23†	-.14	.05	-.12	-.12	-.29*	.06	.08	-.15	-.18	.00	-.19	.52*	.64*
3.2 Group performance (self-rated)	5.71	.71	-.08	-.20	-.16	.09	-.15	.09	-.03	.42*	.16	.26†	-.28*	.09	-.14	-.29*	-.09	.09	.08	-.01	-.17	.09	-.20	.26†	.71*
3.3 Group performance (instructor-rated)	5.58	1.05	.08	-.20	-.02	-.17	.16	.12	.05	.43*	.26*	.21	-.28*	-.09	-.01	-.45	.14	.06	.15	.06	-.06	.24†	-.28*	.05	.35*

Note. * $p < .05$, † $p < .1$ N= 61 groups, except for study course, psychological safety in groups at the midpoint, and group performance at the end, N=60.

Table 8 (continued)

	Midpoint		End	
Variable	2.1	2.2	3.1	3.2
Midpoint				
2.1 Psychological safety				
2.2 Group performance (self-rated)	.57[*]			
End				
3.1 Psychological safety	.66[*]	.63[*]		
3.2 Group performance (self-rated)	.47[*]	.80[*]	.73[*]	
3.3 Group performance (supervisor-rated)	.12	.57[*]	.28[*]	.59[*]

Regarding the Big Five, conscientiousness (groups' mean), agreeableness (groups' mean), and neuroticism (groups' s.d.) were significantly associated with psychological safety: The more conscientious and agreeable groups were, the higher they assessed psychological safety at the end of the project.

6.3.3   Reasoning of Control Variables for the Linear Growth Curve Model

Due to the complexity of our tested model, we reduced control variables to the least possible number according to their theoretical contribution to our model (Becker, 2005). Based on the correlation of the control variables among each other and with psychological safety, we excluded some control variables, which are meaningful in team studies in general, but can be neglected in our study's context. First, our groups were assigned to groups of almost the same size, thus group size will not contribute in a meaningful way to our model. Second, attributes of the faultline are often intercorrelated, e.g. age and tenure. However, as they share the same variance, they might shadow possible effects due to multicolinnearity. Because the difference in group members' theoretical knowledge of psychology in terms of their tenure was more important than the minor differences in age, we included tenure (semester term) in our final model calculations.[7]

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[7] We tested for the effects of the number of subgroups calculating a dummy variable for strong and weak faultlines (+/- 1 *S.D.*). Further, we tested for the effect of subgroup size on individual level. However, these predictors did not contribute to the model. Thus, we did not include them in our final model.

6.3.4 Modelling the Effects of Time and Group Diversity on Group Psychological Safety

We used Linear Growth Curve Modeling in R (R Development Core Team, 2012), a multi-level based approach that allows us to study changes in our data (Bliese, 2016). This way, we can predict initial levels and changes of psychological safety over time. Thus, we had three levels of analyses with measurement points on the lowest level (level 1), nested in individuals (level 2), nested in groups (level 3). We restructured the dataset according to a new variable, namely Measurement Time with the attributes 0 (initial levels), 1 (midpoint), and 2 (end).

In a first step, we fitted the model's structure (Bliese, 2016), testing for the effects of time on changes in psychological safety. Second, we added control variables on individual level to the model. Third, we predicted initial levels of psychological safety by adding the focal predictor demographic faultline strength to the model, when controlling for effects of surface-level diversity on initial levels of psychological safety. Fourth, we added deep level diversity in terms of attitude towards teamwork (mean values and standard deviation) to predict initial levels of psychological safety, when controlling for main effects of task-specific skills and personality (mean values and standard deviations). Fifth, we predicted changes of psychological safety by modeling an interaction of the focal predictors task-specific skills and the Big Five (means and standard deviations) with time to the model, when controlling for effects of the demographic faultline strength and attitude towards teamwork (mean and standard deviation).

All predictors on group level were grand-centered added to the model, except for the demographic faultline strength and group diversity regarding gender and course of study which were z-standardized. All tested models with the respective coefficients, variances and fit indices are presented in Table 9.

6.3.4 Fitting the Model's Structure

First, we ran an unconstrained (null) model and found confirmation for our multilevel structure. As such, 25 % of the variance in psychological safety can be explained by the properties of the group (Bliese, 2016).

Second, we calculated a random intercept, fixed slope model, by adding Measurement time, a level 1 variable, to the model. A comparison of the models' deviations showed that a random intercept, fixed slopes model had a significant better fit compared to our null model (Δ-$2LL$ (2) = 11.12, $p < .001$). In the next step, we tested a random intercept, random slopes model, allowing slopes to vary as well. Again, this model had a significant better fit compared to the former model (Δ-$2LL$ (2) = 22.63, $p < .001$). Third, we tested for autocorrelation among measurement points. This model had no

Table 9

Results of Linear Growth Curve Modeling: Time, Demographic Faultline Strength and Group Diversity Predict Initial Levels (Intercept) and Changes (Slope) in Psychological Safety over Time

Parameter	Model 1	Model 2	Model 3	Model 4	Model 5
	b (SE)	*b (SE)*	*b (SE)*	*b (SE)*	*b (SE)*
Fixed Effects Level 1 (Time)					
Intercept	6.09 (.07)*	6.09 (.08)*	6.11 (.08)*	6.12 (.08)*	6.12 (.08)*
Time	-.10 (.03)*	-.10 (.03)*	-.10 (.03)*	-.10 (.03)*	-.10 (.03)*
Fixed Effects Level 2 (Group Members)					
Gender		-.12 (.10)	-.11 (.11)	-.09 (.11)	-.09 (.11)
Study course		.05 (.10)	.03 (.11)	-.02 (.11)	-.02 (.11)
Semester term		.00 (.05)	.00 (.07)	-.01 (.07)	-.01 (.07)
Fixed Effects Level 3 (Groups)					
Surface-Level Diversity and Mean Values					
Gender, Blau's index			-.02 (.06)	.03 (.06)	.03 (.06)
Study course, Blau's index			.02 (.06)	.03 (.05)	.03 (.05)
Semester term, s.d.			.05 (.11)	-.09 (.11)	-.09 (.11)
Demographic faultline strength			-.11 (.06)†	-.11 (.05)*	-.04 (.08)
Attitudes towards teamwork, mean				.24 (.08)*	.06 (.13)
Task-specific skills, mean				-.08 (.06)	.08 (.09)
Extraversion, mean				.11 (.08)	.07 (.12)
Openness to experience, mean				.03 (.11)	.12 (.18)
Conscientiousness, mean				.11 (.09)	-.07 (.13)
Neuroticism, mean				-.02 (.09)	-.06 (.13)
Agreeableness, mean				.23 (.15)	.43 (.22)†
Deep Level Diversity					
Attitudes towards teamwork, s.d.				-.18 (.12)	-.35 (19)†
Task-specific skills, s.d.				.08 (.12)	-.02 (.18)
Extraversion, s.d.				.14 (.09)	.18 (.14)
Openness to experience, s.d.				-.07 (.12)	.11 (.18)
Conscientiousness, s.d.				-.21 (.13)	-.26 (.19)
Neuroticism, s.d.				-.19 (.10)†	-.35 (.14)*
Agreeableness, s.d.				.36 (.18)*	.69 (.27)*
Cross-Level Interactions					
Surface-Level Diversity and Mean Values					
Demographic faultline strength x Time					-.05 (.03)
Attitudes towards teamwork, mean x Time					.11 (.06)†
Task-specific skills, mean x Time					-.10 (.05)*
Extraversion, mean x Time					.03 (.05)
Openness to experience, mean x Time					-.06 (.09)
Conscientiousness, mean x Time					.11 (.06)†
Neuroticism, mean x Time					.03 (.06)
Agreeableness, mean x Time					-.13 (.10)
Deep Level Diversity					
Attitudes towards teamwork, s.d. x Time					.11 (.09)
Task-specific skills, s.d. x Time					.06 (.08)
Extraversion, s.d. x Time					-.03 (.07)
Openness to experience, s.d. x Time					-.11 (.08)
Conscientiousness, s.d. x Time					.03 (.09)
Neuroticism, s.d. x Time					.10 (.07)
Agreeableness, s.d. x Time					-.21 (.12)
Random Effect Variances					
Intercept (Level 3)	.11	.11	.11	.11	.06
Slope (Level 3)	.03	.03	.03	.03	.03
Intercept (Level 2)	.17	.19	.18	.18	.19
Slope (Level 2)	.00	.00	.00	.00	.00
Residual	.23	.21	.21	.21	.21
AIC	1385.22	1400.10	1385.87	1412.34	1477.41
BIC	1425.988	1458.93	1462.47	1551.36	1682.63
– 2LL	1367.223	1374.10	1351.87	1350.34	1385.41

Note. Unstandardized coefficients are presented (with *SE*), * $p \leq .05$, † $p < .1$; all models are random intercept, random slopes models, *– 2 LL = –* 2 Log Likelihood value, $N = 699$ measurements for each group member and each time, nested in $N = 236$ group members and $N = 61$ groups.

significant better fit compared to the former model. Therefore, we allowed intercepts and slopes to vary in further calculations without controlling for autocorrelation in our data (see Model 1, in Table 9).

6.3.5   Effects of Time, Demographic Faultline Strength, and Deep Level Group Diversity on Initial Levels and Changes of Group Psychological Safety

In Model 1, we found that time significantly predicted changes of psychological safety. As such, psychological safety in groups significantly decreased over time (RQ1).

In Model 2, we entered the faultline's attributes gender, study course, and semester term on individual level in order to control for effects above and beyond group diversity effects. Model fit decreased slightly.

In Model 3, we predicted initial levels (intercept) of psychological safety with the demographic faultline strength and group diversity regarding gender (Blau index), study course (Blau index), and semester term (within-group s.d.) on group level as predictors, in order to control for effects of surface-level group diversity above and beyond the demographic faultline strength. Initial levels depended marginally significantly on the demographic faultline strength: The stronger the demographic faultline, the lower groups assessed initial levels of psychological safety to be. Model 3 had a similar fit compared to Model 1. Thus, we found marginal support for H1.

In Model 4, we predicted initial levels (intercept) of psychological safety by adding groups' attitude towards teamwork (mean value and s.d.) as focal predictor, thereby controlling for main effects of groups' task-specific skills and the Big Five (mean values and s.d.s). Initial levels significantly depended on groups' mean attitude towards teamwork (but not on groups' diversity regarding their attitude): The higher groups' attitude towards teamwork was on average the higher groups assessed their initial levels of psychological safety to be. Model fit decreased due to the number of predictors and controls added to the model. However, the tested predictor was significant. Thus, we found support for H2a) but not for H2b).

In Model 5, we predicted changes (interaction with time) in psychological safety with groups' task-specific skills and the Big Five (mean values and s.d.s) as predictors, thereby controlling for effects of the demographic faultline strength and groups' attitude towards teamwork (mean value and s.d.). Changes in psychological safety depended on groups' mean task-specific skills (but not on groups' diversity regarding their skills). However, the effect was differently than expected: The higher groups assessed their task-specific skills, the more psychological safety decreased over time. Changes marginally depended on groups' mean conscientiousness: The more groups were conscientious, the more psychological safety increased

over time. Model fit decreased compared to Model 4. Thus, we found no support for our hypotheses H3 (mean group skills), partial support for H4 (mean group personality), and no support for H5 (diverse group personality).

In summary, we found that psychological safety significantly decreased over time. Initial levels of psychological safety depended (marginally) on the demographic faultline strength and groups' mean attitude towards teamwork: The more positive group members were in their attitudes towards teamwork, the higher they assessed initial levels of psychological safety to be. Changes of psychological safety depended on the groups' mean task-specific skills and conscientiousness: The higher the groups assessed their task-specific skills to be, the more psychological safety decreased over time. However, the more conscientious groups were on average, the more psychological safety increased over time.

6.3.6   Replication of the Positive Relation Between Psychological Safety and Group Performance

Considering the relation between psychological safety and self-rated group performance, correlations were consistently positive and increased in size over time ($r_{Beginning} = .47$, $r_{Midpoint} = .57$, $r_{End} = .73$, see Table 8). The higher the groups assessed their psychological safety to be, the higher they assessed their performance to be at all measurement points. Further, group psychological safety at the end (T3) and supervisor-rated group performance were significantly positively related (.28). Thus, we found support for Hypothesis 6.

6.3   Discussion

First, we addressed scholarly calls for more holistic research regarding time and changes in groups, more specifically regarding the formation and development of psychological safety (Edmondson & Lei, 2014; Roe, Gockel, & Meyer, 2012). As such, we refer to theories from trust research, and the model of group faultlines to provide a theoretical background on how psychological safety builds and is affected by subgroup building (Lau & Murnighan, 2005). A second strength of our study is the focus on the group itself, specifically on effects of deep level group diversity, as an antecedent for the development of psychological safety. Third, we predicted initial levels and changes in psychological safety by using a longitudinal design and multilevel modeling.

This study serves to deepen our understanding of psychological safety. First, we found that psychological safety decreased over the course of a group project. Second, initial levels in

psychological safety are dependent on the demographic faultline strength and group members' high attitudes towards teamwork. Third, changes in psychological safety depended on group members' mean value in task-specific skills and conscientiousness. Finally, we replicated the positive relationship between psychological safety and self-rated group performance at each point of measurement and supervisor-rated performance (only with groups' assessments at the end of the project). We start our discussion by addressing the development of psychological safety found in our study: Most groups started out at initially high levels, which significantly decreased over time.

The decrease of psychological safety over time is in line with the descriptive statistics reported by Schulte et al. (2012). Indeed, time had the highest share in explaining variance, while the other predictors did not add further value. We have two explanations for these findings: One explanation is that, at the beginning, it is commonly acceptable to allow many questions in order to form a transactive memory system in the group about which member possesses what knowledge, and which member is an expert on what topic (Gockel & Brauner, 2013; Moreland & Myaskovsky, 2000). However, after this initial period, most group members may think that the task is clear, and first actions should be taken. In this phase, questions could be perceived as rather irritating and may slow down the work. Yet because the first sessions set standards, psychological safety is high at the beginning, followed by a consecutive decrease over time. At the finish line, a final critical consideration of one's own group work is important for perceived group performance; however the group may already be too "closed off" in order to reopen the discussion or allow feedback loops, and this closing phenomenon is reflected in a decrease in psychological safety. One finding that supports this consideration is that groups with a high need for closure, which might be triggered by time pressure, are less open for critical discussion (Pierro et al., 2003).

The second explanation refers to a phenomenon found in trust research (Lewicki et al., 2006). It is reasonable that, at the first meeting, group members evaluate their psychological safety based on other criteria than on their experience with risky behavior in the group, because they may not yet have had enough experience with this specific group. For instance, they could have used the groups' structure (self-managed groups without formal leader), or other status signals such as gender, age, or floor-gaining behavior for first impressions. Thus, members gave a leap of faith and psychological safety to the group, which was to be evaluated later during group work (reflected in lower group agreements at midpoint). Perhaps, up until this point, group members shared no "real" psychological safety, but instead an anticipated credence of psychological safety. Thus, enthusiasm at the start as a kind of initial ignition to get the work started and its reduction over time appears not to be unusual for group work (e.g., romance of teams or honeymoon-hangover effect from research on newcomers' job satisfaction, Allen &

Hecht, 2004; Boswell, Boudreau, & Tichy, 2009).

Initial levels of psychological safety depend on the demographic faultline strength and groups' attitude towards teamwork. Our findings add to former research in this area. First, they strengthen the idea that psychological safety forms in subgroups, as we showed that a strong demographic faultline could explain dynamics on subgroup level from the very beginning. As such, a strong faultline based on overt features such as gender, age, tenure, and functional background had an overall negative effect on psychological safety beliefs from the very beginning. This is in line with a discussion by Lau and Murnighan (2005) that strong demographic faultlines have a "direct and potentially pervasive effect" (p. 655) on group processes without being salient or activated at a specific point in time and therefore should affect group processes right from the start. As such, group members are more likely to identify with the own subgroup, share sensitive information with close members of the respective subgroup than with the entire group which leads to more isolated communication and information sharing and a reduced psychological safety (Lau & Murnighan, 2005). Further, a theoretical paper on how psychological safety forms depending on the ties formed in networks through social contagion processes strengthens 1) the idea that psychological safety emerges in subgroups, and 2) that the focus should shift from a leader-centristic perspective to a group level perspective. As such, group faultlines encompass both approaches as the formal position could be modeled as an attribute of the group faultline, or subgroups could be analyzed in terms of including or excluding the leader in a subgroup (see Meyer et al., 2015). A valuable approach could be measuring subgroup perceptions via network indices in order to better understand teams in which subsets feel psychologically *un*safe or single individuals that strongly vary from the others (e.g., an outsider-effect, for more details see the theoretical paper about a multilevel approach to team psychological safety, Roussin, MacLean, & Rudolph, 2016).

Bell (2007) stated that attitude towards teamwork on a group level was important for processes and group performance, and Ulloa and Adams (2004) found a positive relation between attitude towards teamwork and psychological safety on the individual level. Our study's findings are in line with this research. As such, the mean value (but not the standard deviation) regarding attitude towards teamwork led to higher perceptions of psychological safety. Therefore, only if group members have high attitudes towards teamwork, e.g., most group members enjoyed group work and had positive expectations about the potential benefits of group work, groups started with high initial levels of psychological safety.

Changes in psychological safety over time depends further on the group's task-specific skills. Different than expected, the higher the group members rated their own task-related skills to be at the beginning of the project, the more psychological safety decreased over the course of time. An explanation for our result may be that members of a group with high task-specific skills

are more likely to believe that they are right, stick to their positions, and disregard the opinions of others. The following finding supports this interpretation: Groups that needed to find a consensus in order to solve the NASA moon landing task showed different communication patterns dependent on the diversity of their task-relevant skills (Innami, 1994). As such, groups with high task-specific skills held on to their positions (*positional orientation*) and did not explain their convictions to others (*reasoning orientation*). Time pressure may strengthen this communication behavior as group members fail to understand the importance of explaining task-related issues to each other.

We had reason to believe that the Big Five would predict changes in psychological safety by driving certain learning behaviors that are characteristic for psychological safety. This was only the case for conscientiousness. This is in two ways an important finding: First, it means that the context-driven attributes are more important for changes of psychological safety on group level, than traits like extraversion, openness to experience, agreeableness, or neuroticism. Second, only highly conscientious groups showed an increase in the development of psychological safety. This could be the case, because groups high in conscientiousness share the need to detect errors and problems to solve them properly and in time building an opposite pole to the need for closure in groups because group members feel the urgency of voicing critical errors or problems that need to be solved. Further, we need to address findings, that we did not theoretically expect, but tested for: As such, the more agreeable groups were, the higher they assessed initial levels of psychological safety to be. At the same time, the more diverse groups were in agreeableness and neuroticism, the higher they assessed initial levels of psychological safety to be.

In sum, our findings support the idea that psychological safety unfolds based on the group's attitude, skills, and personality. However, for the development, it is more important which skills are brought into the team and how they are utilized than how the group is composed in terms of its personality (except for conscientiousness). Although these findings are encouraging, they should be considered with caution. Apart from theoretical considerations, a statistical explanation is that correlations between predictors may have suppressed effects of the single Big Five dimensions in our model. Furthermore, our findings add to Edmondson and Mogelof's (2005) findings in creative teams, where openness and neuroticism (at an individual level) predicted perceptions of psychological safety at midpoint and at the end of collaboration. It is plausible that, if teams understand the value of psychological safety group members' personalities have a greater effect on the development of psychological safety. In our study, only conscientiousness (at a group level) was positively associated with changes in psychological safety. However, we did not predict psychological safety at midpoint or at the end, but changes over the time of collaboration adding to former findings this way.

Finally, we replicated the positive association for each time-sensitive point in the

collaboration process and confirm the perceptual relationship between psychological safety and performance: The higher the groups perceived their psychological safety to be, the higher they assessed their group performance to be at the beginning, at midpoint, and at the end of the project. The final groups' assessment of psychological safety was related with supervisor-rated group performance as well. Thus, high groups' perceptions at the end could help detect flaws and keep a constructive focus on teamwork in order to performance the best. This finding underpins the relevance of studying changes of psychological safety over time, in order to promote the development in form of an increase or high stable patterns towards the end of group project.

6.4.1 Limitations and Future Research

A few limitations must be pointed out as well. These groups are characterized by demographic homogeneity (e.g. age, gender, educational background, experiences in group work). Thus, our results should be generalized with caution. The study should be replicated with different kinds of teams in various organizational contexts. Nevertheless, our study's setting fulfilled the requirements for self-managed group work.

In regards to our methods of measurement, we assessed and correlated self-ratings of psychological safety and group performance. The results may be biased due to them being of the same source, and the data only represent the group's perceptions and does not allow for comparison to another source. Therefore, it would be beneficial for future researchers to include objective ratings of the process of group psychological safety. For instance by observing group meetings and coding behavior, or using sensor devices like sociometric badges used in emergent leadership research that register the spatial distance of group members and further paraverbal indices that could reveal more about individuals' risk perceptions in the specific team situation (Cook & Meyer, in press). This apporoach might be valuable in gaining insights on the formation of psychological safety perceptions when team members first meet. However, we know that oftentimes individual or group perceptions are more important than other-rated processes, especially when considering group processes. Thus, it is important to complement self-ratings by adding ratings as suggested in future studies. Furthermore, the separation of the assessment of predictors and processes in the beginning more clearly is recommended, which can be achieved by adding an additional point in time (e.g., T0) prior to the begin of the collaboration.

Finally, we would like to address new research questions resulting from our study as well as different strategies to analyze them in future research. For instance, emerging group leaders with longer speaking times (floor gain) may be "enough" to signal psychological safety to the entire group. A possibility to analyze the data to answer such a question may be the application of an Actor-Partner-Interdependence Model (APIM, Kenny, Kashy, & Cook, 2006; for an

application to groups to Gockel & Werth, 2010), in which the effects of one's own actions and fellow group members' actions on individual perceptions of psychological safety could be investigated more precisely. As such, the effects of personality factors such as extraversion, openness, or conscientiousness of group members could be embedded in a stronger theoretical framework, namely in emergent leadership, unfolding its influence over time.

We found that groups had different trajectories over time. One last shift of focus we would like to address is the intrateam-longitudinal approach, which was introduced by Li and Roe (2012). By clustering trajectories of group processes and not aggregating mean scores per measurement point, we would gain new research questions and answers concerning the development of psychological safety. For example – do groups with steady high psychological safety assessments perform better than groups with increasing or decreasing safety? Is it important whether or not psychological safety is high from the beginning, or rather from midpoint? This method allows one to examine the changes of each single group more precisely, and to test for differences between groups with different trajectories, than to aggregate mean scores and report overall tendencies.

6.4.2 Implications

We can draw specific implications from our study. First, focusing only on the leader is not a sufficient way to create a psychologically safe atmosphere for teamwork. We found that demographic faultline strength and deep level diversity had an effect on initial levels as well as changes in psychological safety. Our study positively stresses the importance of states and changeable variables, namely attitude towards teamwork and task-specific skills, rather than traits (e.g., basic personality, except for conscientiousness) for the development of psychological safety. The fact that psychological safety decreased over time once more stresses the importance of time-related team interventions.

Therefore, at the beginning of a project, we recommend to increase positive attitudes towards teamwork in a team intervention, for instance by explaining the goal and meaning of teamwork for the respective task. The goal should be that team members develop positive and realistic expectations towards teamwork and will understand the importance of interdependence in groups. Even within the first minutes of the first meeting, it is also important to convey understandable signals of psychological safety; for instance, by stressing that all members are welcome to speak their mind or to question work routines in a constructive way, and by encouraging them to understand problem solving and detecting mistakes as a challenge and a chance to learn (cf. Hackman & Wageman, 2005; Nembhard & Edmondson's concept of leader inclusiveness, 2006).

Around midpoint, we further recommend stressing pro-diversity beliefs in combination with enhanced task motivation in order to overcome the negative effects of group faultline strength from the beginning (Meyer & Schermuly, 2012). In this regard, communication skills could be trained following Innamis model (1994), by stressing the importance of explaining one's own view to the group and not holding on to positions without further elaboration. This is especially advisable for groups with highly perceived skills (e.g., expert teams), as our results showed a decrease of psychological safety in such groups over time.

Towards the end, a reminder of the midpoint intervention (diverse opinions are enriching, and a conscientious working focus is essential to improve the team output) could help keeping the group open and not let it close too early in order to make final changes that the project could substantially contribute from.

Hackman and Wageman (2005) stress the importance of the team's receptivity for input depending on the teams' life cycle and history. Aside from high task demands that hinder an intervention from being effective, the team's readiness is bound by internal and external cues about passed time (Mann, 2001). Thus, transition points, e.g., a successful completion of a subtask or midpoint, serve as a well chosen window in time for strategic interventions such as enhancing team members' skills or improving decision-making procedures to overcome a drop in psychological safety and possible negative effects of demographic faultline strength. In particular, our findings suggest strengthening psychological safety at the end, because high levels of psychological safety at the end were significantly related with supervisor-rated performance.

6.4.3   Conclusion

Our study shows that psychological safety possesses changing properties in terms of an overall decrease over time in groups. Whether or not group members felt welcome to share ideas with each other from the start depended on the demographic faultline strength and on the groups' attitude towards teamwork. Additionally, changes of psychological safety over time depended on the groups' mean task-specific skills and conscientiousness. Our study contributes to research in regards to psychological safety by introducing the subgroup perspective on group dynamics and by shifting the focus from the leader (who is often seen as the primary source of influence) to the group as whole. It introduces a theoretical framework for temporal dynamics in psychological safety and provides empirical evidence on how psychological safety forms and develops over time in order to take the timing in consideration when planning interventions to enhance psychological safety in teams.

7   Study 3 – About the Effects of Relative Changes of Psychological Safety over Time on Team Performance

Title: A Change Would Do You Good: Initial Levels and Changes of Psychological Safety during the First Half of a Project Predict Team Performance

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Abstract

Team members feel psychologically safe when they believe that interpersonal risks can be taken without a loss in status or image. Psychological safety is one of the most important predictors for team effectiveness, yet up to now, we know little about how it develops, and whether changes have a unique influence on team effectiveness. Therefore, we investigate team trajectories of psychological safety over time, and relate initial levels and changes of psychological safety in the first half of a project with team performance.
Fifty-nine teams completed a research project over five months. Team members assessed their own psychological safety at the beginning, midpoint, and end of the project. Instructors rated team performance upon project completion. Using linear multiple regression, initial levels and changes of psychological safety perceptions in the first half of a project, significantly predicted team performance. As such, high team performance depended on high initial levels of psychological safety *and* an increasing or stable pattern towards the midpoint of collaboration compared to a decreasing pattern. Therefore, interventions to increase team performance should focus on enhancing psychological safety from the start and in the first half of a project. The theoretical and methodological contributions for team research as well as practical implications are discussed.

Keywords: Psychological safety, changes, team trajectories, team performance, intra-team, longitudinal study

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7.1   Introduction

Psychological safety has been identified as a key factor for the effectiveness of teamwork (Bergmann & Schaeppi, 2016). Members perceive their team as psychologically safe if they feel free to express their ideas and to share contributions without the risk of status or image loss (Edmondson, 1999). Numerous studies confirm the positive relation between psychological safety in teams and team performance (Edmondson & Lei, 2014; Newman, Donohue, & Eva, 2017). Researchers often treat psychological safety as a static variable, though agreeing it is an emergent concept underlying temporal dynamics (Edmondson & Lei, 2014).

Researchers have been considering the effects of time on group processes since the 1940s (e.g., Bales, 1950; Lewin, 1947; McGrath, 1964). However, this perspective got lost with the rise of differential statistic approaches testing for Input-Process-Output models demonstrating the relation between two variables at a point in time. Teams change constantly as hypothesized by group development theories such as the punctuated equilibrium model by Gersick (1988), or linear progression models, e.g., by Wheelan (1994). Increasing calls to include time and change initiated a shift of paradigm towards a temporal approach in team research (Roe, 2008; Roe, Gockel, & Meyer, 2012). First evidence supports these claims by demonstrating that changes in conflict, or the early development of shared team perceptions affect team performance above and beyond absolute levels (Li, Jehn, & Roe, 2016; Li & Roe, 2012; van der Haar et al., 2015).

Thus, our focus lies on teams' individual histories of psychological safety by relating initial levels and the changes during the first half of a project with team performance. This is valuable for several reasons: firstly, we treat psychological safety according to its definition as a relational phenomenon that changes over time. As such, it can be strengthened or disrupted by positive or negative experiences within the team. Secondly, by examining patterns of psychological safety trajectories, we build on the strong link between psychological safety and team performance, gaining insight into *how*, and *when* changes of psychological safety exert unique influences on team performance. Thus, we offer a new theoretical perspective on the unique nature and function of changes of psychological safety, and their relationship with team performance over time. Together, these insights contribute to the development of a much-needed dynamic perspective on psychological safety, as changes within teams might be more meaningful for team performance (or other variables such as learning behavior, voice, or the commitment, intention to leave, or team satisfaction). Based on this theoretical development, practitioner might draw conclusions of how and when to intervene effectively to foster psychological

safety, and eventually team performance.

We hypothesize that teams in which psychological safety remains stable or increases during the first half of a team project, will out-perform teams in which psychological safety decreases in this phase (Gersick, 1988). The first half of a project is especially important, because this is the time for team members to lay the foundation for a successful transition around midpoint, and the accomplishment of this transition point separates high performing teams from low performing teams (Gersick, 1988; Jehn & Mannix, 2001; van der Haar et al., 2015). As such, an increase or stability of psychological safety in this phase paves the way for passing the transition at midpoint by opening up the team for potential changes such as new leader behavior and strategic reconsiderations.

7.1.1 Psychological Safety in Teams

Psychological safety in teams is a shared belief by members that the team "is safe for interpersonal risk taking" (Edmondson, 1999, p. 354). Interpersonal risk taking refers to behaviors such as addressing problems, seeking help from other team members, or admitting individual mistakes without fearing status or image losses (Edmondson, 1999, 2002). As such, psychological safety is primarily considered as a concept on the team level, but may be examined on an individual or organizational level as well (Edmondson & Lei, 2014; Newman et al., 2017).

Psychological safety is a solid predictor for team performance and, depending on the theoretical model, has been examined in a moderating or mediating function in this relation (Edmondson & Lei, 2014; Newman et al., 2017). Compared to teams with low levels of psychological safety, teams with high levels of psychological safety are more creative, show more learning behaviors and higher performance levels, share more information, and profit from high task conflict (Bradley, et al., 2012; Edmondson, 1999; Gong, Cheung, Wang, & Huang, 2012).

Leaders play a central role in shaping perceptions of psychological safety; for instance, by inviting team members to share contributions and diverse opinions, referred to as leadership inclusiveness (Nembhard & Edmondson, 2006). Aside from leaders, close co-worker relationships significantly impact team members' perception of psychological safety through a high quality of information exchange (Carmeli & Gittell, 2009), relation-associated rewards such as appreciation, respect, or trust, and a reduced necessity to adhere to co-worker norms (May, Gilson, & Harter, 2004). A network study demonstrated that perceptions of psychological safety co-evolved with friendship networks over time (Schulte, Cohen, & Klein, 2012).

Most studies provide data from a single time point of psychological safety and team performance (Bradley et al., 2012; Edmondson, 1999). Although considerable research links psychological safety to team performance (reviewed in Edmondson & Lei, 2014, and Newman et al., 2017), previous studies have three main limitations. First, reviews of the literature have noted that most studies follow a static approach that fails to capture the dynamic nature of psychological safety and team performance processes (Edmondson & Lei, 2014, Newman et al., 2017). Second, two empirical studies have focused on the development of psychological safety (Edmondson & Mogelof, 2005; Schulte et al., 2012). Yet, extant theories have not sufficiently explained how psychological safety forms and develops in the first place (cf. trust development models by Lewicki, Tomlinson, & Gillespie, 2006). In this regard, it is unknown whether psychological safety is important for team performance right from the start, or at a later (critical) point in time. Third, prior theory and research have not adequately focused on patterns of changes of psychological safety and its relationship with important organizational factors. Because psychological safety is identified as the number one predictor for team performance (Bergmann & Schaeppi, 2016), we examine the unique influence of relative changes of psychological safety above and beyond absolute levels on team performance. An examination of psychological safety through a temporal lens more adequately captures the concept of psychological safety, provides stronger implications for theory, and gives hints for practical solutions (Mitchel & James, 2001). Accordingly, our aim is to embed the temporal dynamics of psychological safety into a theoretical framework of group development theories, more precisely, we refer to the model of punctuated equilibrium by Gersick (1988), and test for the effects of initial levels and changes of psychological safety on team performance. Therefore, we consider a team's entire life cycle from formation to completion of a collaborative project.

As changes should be considered in relation to a baseline or reference value, we begin our theoretical considerations by describing how initial levels should affect team performance. Following, we hypothesize *how* and *when* changes of psychological safety should have a unique influence on team performance.

7.1.2 Initial Levels and Changes of Team Psychological Safety Predict Team Performance

Initial Levels of Psychological Safety. Team members are sensitive to signals of psychological safety from the first minutes of interaction (Hackman and Wageman, 2005).

Signals may be non-verbally or verbally communicated; for instance, by eye contact or the explicit invitation of team members to share ideas among each other. Similarly, a harsh reaction of a team member with high status in a group discussion could cause a sudden drop of psychological safety. As individuals usually give a leap of faith to each other when entering new group situations (Lewicki et al., 2006), it is likely that initial levels of team psychological safety are moderate to high. Strong negative experiences within the first meeting may damage perceptions of psychological safety, leading to silencing group discussion norms from the start. Based on the view that the initial encounter, especially the first meeting, is important for the subsequent collaboration, because implicit and explicit norms are set, e.g. regarding cooperation and performance levels (Hackman & Wageman, 2005), and we believe that is particularly true for perceptions of psychological safety. Thus, we believe that teams setting a high climate of psychological safety from the very beginning will outperform teams in which members lack these perceptions. We therefore propose the following:

Hypothesis 1: Initial levels of team psychological safety predict team performance. The more team members believe that their group is safe for inter-individual risk taking from the start of the project, the better these teams will perform.

Changes of Psychological Safety. In addition to high initial levels of psychological safety, changes such as an increase, stability, or a decrease of psychological safety perceptions, will affect team performance. Changes compared to absolute values of psychological safety are important for team performance as two teams could assess their psychological safety moderately, e.g., with a 4 out of 5 points. Yet, they might come from different baselines, and, thus, the same value might have different meanings for the teams. In one team, members might have realized that the atmosphere became more tense and that they cannot be as open anymore (baseline value = 5). Still, these teams might have experienced high psychological safety levels for quite some time, thus, even a small change in team members interactions might have a severe effect reflected by a grading psychological safety levels one point down. In the other team, they have realized that they can open up more (baseline value = 3). However, when do team members decide that it is safer to take interpersonal risks? Coming from a lower level, team members might need more clear signals over a longer period to adjust their psychological safety assessment upward. Thus, the relationship between a one-time measurement of psychological safety with team performance should differ, though they achieved the same absolute value.

Group development theories such as the punctuated equilibrium model by Gersick (1988) stressed the importance of three particular points in a team's life cycle for studying changes: The beginning, the midpoint, and the end. Gersick (1988) observed that teams did

not develop in a linear fashion but through two balanced phases in which work strategy did not alter much, punctuated by a radical transition point most likely around midpoint. The accomplishment of this crucial transition after half of the time has passed separated high from low performing teams (Gersick, 1988). Thus, time itself is a trigger for changes in groups because group members call attention to time experiencing time pressure when realizing how much time has already passed Gersick (1988). At midpoint,

> high performers engage in a concentrated burst of activities and adopt new perspectives. This activity includes discussions of task goals and debate around various opinions of team members to determine the specific content of the final product or decision. (…) Laying the groundwork in the early stages of interaction will allow groups to make this crucial transition, in which they focus solely on the task, rather than on procedures and relationships. (Jehn & Mannix, 2001, p. 241)

All reported activities mark a successful transition around midpoint and may be summarized under the umbrella term of learning behavior, which is strongly related to a high climate of psychological safety (Edmondson, 1999). Compared to teams in which psychological safety decreases in the first half, teams with an increasing pattern should be able to accomplish the needed transition around midpoint to a better extent.

Complementary to Gersick's (1988) theoretical perspective, Chang, Bordia, and Duck (2003) stressed dynamics in the early phase of team development. Chang et al. (2003) integrated the most popular theories on how groups develop, the equilibrium model (Gersick, 1988) and the linear progression theory (e.g., Wheelan, 1994). They presented evidence that groups developed in linear progressive patterns as well as in punctuated developmental patterns. However, only 9 of 25 observed teams experienced a radical change at midpoint. In 12 of the remaining 16 teams, small changes occurred at the beginning of the project. Thus, besides the preparation *for* the transition around midpoint, teams have to handle possible transitions *within* the early phase of a project, when goals and roles have to be cleared, and tasks need to be distributed among team members (integrative model of the punctuated equilibrium model and a progressive model on team development by Chang, Bordia, & Duck, 2003). As such, an increase or stability in open and constructive dealings with queries and issues in the early phase of a project may help the team to start and move forward. Yet, because high performing teams show process discussions within the early phases of interaction, and at midpoint (Gersick, 1988). We believe that teams place their anticipated perceptions of psychological safety, based on signals from the first superficial encounter, to a test within the following early interactions. Consequently, if teams perceive these encounters as fruitful and safe, their psychological safety is validated

in a positive way and increases or remains high and stable. If early encounters fail, this may lead to a decrease in team perceptions of psychological safety, affecting team performance in a negative way. We therefore propose the following

Hypothesis 2: Changes of team perceptions of psychological safety in the first half of a project, predict team performance. As such, a) teams with either an increase in or b) stable trajectories in the first half of project, will outperform teams with a decrease.

After teams have passed the transition around midpoint, heading into a new direction or having agreed on continuing to move into the same direction as before, they still have to fulfill certain tasks. Teams need to formalize decisions, present their progress, stick to the plan, and edit or finalize products or presentations (Gersick, 1988). High psychological safety may be as important as before, but changes or minor fluctuations may be neglected, once the early transitions are mastered. Thus, teams can rely on early laid foundation for risk-taking beliefs, and a further decrease or fluctuation should not affect team performance in a significant way.

To gain insight into what happens in the teams, we included time in our theoretical hypotheses, and follow the temporal approach in team research (Roe, Gockel, & Meyer 2012). We focus on the integrative group development theory and patterns of changes of psychological safety by using the intra-team longitudinal approach (Li & Roe, 2012). According to the intra-team longitudinal approach (Li and Roe, 2012), teams whose trajectories are similar to one another are clustered into one category; describing the change pattern of teams as stability, or either a continuous increase or decrease. This method allows testing for temporal changes, with consideration of the individual history of each team, rather than an averaged trend across teams obtained from growth curve models. The approach builds on the idea that the teams' change patterns are independent of each other and therefore can show different qualities. The intra-team longitudinal approach identifies change patterns per team and categorizes changes based on similarity and dissimilarity in the teams' trajectories (Li & Roe, 2012). The identified change patterns are used to predict a relevant outcome such as team performance. The method provides knowledge on change patterns and on how and when changes influence team processes. Recently, Li, Jehn, and Roe (2016) published a further study based on the intra-team longitudinal approach testing dynamic mediation models. They found that team diversity regarding masculinity and power distance was associated with changing patterns of relationship, process, and task conflict, in turn affecting team performance and satisfaction differently. As such, an escalation of task conflict was associated with lower levels of team performance, whereas a rise in relationship and process conflict was associated with lower levels of team satisfaction. The effects of changes were observed in addition to absolute levels of intra-

team conflict demonstrating knowledge gained by the consideration of time in team research based on this innovative approach.

A recent study using the same methodological approach supports the relevance of changes in the early phase of a project for team functioning (van der Haar et al., 2015). Teams with a changing pattern in the early development of a team situation model (TSM, a shared understanding on what actions need to be taken in the specific situation), out-performed teams with a stable pattern (van der Haar et al., 2015). The authors discuss the relevance of learning behaviors that are strongly related with psychological safety to foster information sharing, confronting controversy, and rewarding team members for speaking up in order to develop a TSM. A further concept that is of apparent relevance, in the context of team dynamics and team performance, is intra-group conflict (Li & Roe, 2012). A linked analysis of teams' change patterns of task, relationship, and process conflict, to team satisfaction levels, found that teams with a continuous decreasing pattern or an inverted u-shape in all three conflict types, reported higher satisfaction levels compared to teams with an increase in the second half of a project (Li & Roe, 2012). An overall decrease of intra-group conflict, especially in the second half of a project, leads to higher levels of team satisfaction. These studies support our findings in such a way as an initial increase of psychological safety may have side effects on the development of other relevant processes such as changes in the development of a TSM, or decrease of task conflict with focus on the second half, that are linked with team effectiveness.

Therefore, placing changes of team psychological safety perceptions front and center of our theoretical elaboration and empirical investigation of teams will advance our understanding of how teams develop, adapt, and perform over time.

7.2   Method

7.2.1   Participants

Our study was part of a larger team research project conducted at Technische Universität Chemnitz. Fifty-nine[8] three to four member teams participated in this study. In total, 235 students responded to our questionnaires over five semesters of data collection to reach an adequate number of teams with different trajectories of psychological safety. They completed a university research project over five months in their second year of study.

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[8] Preliminary analyses of the originally 60 teams showed an outlier in the instructor-rated team performance. Thus we excluded team #17 (4 members) from all analyses leaving 59 teams in total.

Teams were comprised of a majority of (72 %) female students from two disciplines (62 % psychology, 33 % cognitive sciences, and 5 % missing values) and of young age ($M =$ 21.83, $SD = 3.38$, $Min = 18$, $Max = 44$).

7.2.2 Team Task and Recruitment of Participants

Students who passed their statistics and methodology examinations were required to register online to complete a course in experimental research. In the class, each research teams' task was to design and conduct an empirical research project from theoretical framework, namely literature research and hypothesis development, to building the experiment, recruiting participants, and finally analyzing the data and explaining the findings in a written research report.

We invited research teams to participate in our study at their first meeting with their instructors, which is also the point the students formed their respective teams. We informed teams that we were interested in how they worked together over the time of collaboration, that participation was voluntary. In exchange for every completed questionnaire, students received research credit points; and teams who completed all measurement points were eligible to enter a draw to win a restaurant voucher.

Team members were highly motivated to work together and to make good decisions from the beginning because their grades were connected with this team project. As psychological safety is especially relevant in learning contexts (Mu & Gnyawali, 2003), the development of psychological safety and change over time should be well observable in these research research teams.

7.2.3 Design and Procedure

Teams were invited to participate in the study and requested to complete a questionnaire including demographic data, trait variables, and questions regarding their acquaintance with the teammates at the introductory session (T0). During their collaboration, team members assessed their psychological safety at three measurement points, at four-week intervals, to enable investigation of the early beginnings of psychological safety, as well as changes in the first and second half of a project. The specific measurement points were chosen according to the seminars' work plans: Two weeks from course commencement (T1), teams completed a literature research for their theoretical framework and one team per course presented important steps how to do a

literature review in the seminar. In addition to the leap of faith team members give each other at the beginning of an interaction process, team psychological safety is a team construct, relying on shared perceptions of common experiences. Thus, during this first partial team task, team members could gain initial experiences in the team, that we coded as baseline of psychological safety. At the midpoint of the project (T2, week 8), teams presented their methods at the midpoint of the project. At the end of the project (T3; week 15), but prior to their deadline for the final scientific report, teams presented and discussed their results. The process questionnaire contained additional measures such as leader emergence, which are presented elsewhere. Four weeks after teams submitted their final scientific reports, we asked instructors to rate the performances of their teams (T4; week 22). For an overview of the research design and measurement points, see Figure 5.

Teams had time to answer the questionnaire within one week at maximum

T0 (At first Meeting) – teams assessed demographic attributes

T1, T2 and T3 – teams assessed psychological safety

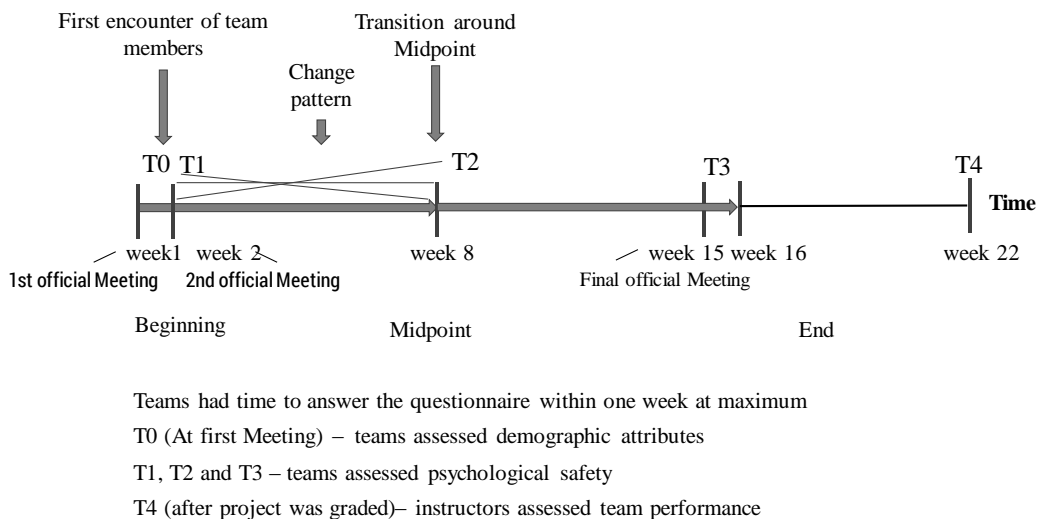T4 (after project was graded)– instructors assessed team performance

Figure 5. Overview of the Longitudinal Research Designs and Measurement Points.

7.2.4 Measures

Team Psychological Safety. Edmondson's Team Psychological Safety Scale[9] was modified to assess team members' perceptions of psychological safety (Edmondson, 1999). The term "team" was changed to "group". Example items are "If you make a mistake on this group, it is often held against you" (reverse scored), and "Members of this group are able to bring up problems and tough issues". We translated the scale into German, obtaining a measure with good reliability with α_{T1} = .75; α_{T2} = .77; and α_{T3} = .83 (six items). Teams rated the frequency of behavioral events with the anchors 1 (never) and 5 (almost always), and not as originally intended by Edmondson the extent to which they agreed with the statements. This way, team members had to refer to specific team meetings and incidents to assess their psychological safety level.

Instructor-Rated Team Performance. Instructors were asked to evaluate team performance on eight items after the project was completed. Five items were retrieved from the Team Evaluation Form (Lent, 2002, used and developed for the learning context with students by Lent, Schmidt, & Schmidt, 2006), for example "this team met their deadlines"; and three items from the Team Performance Scale (Lam, Schaubroeck, & Brown, 2004), e.g., "this team was competent" and "this team effectively accomplished their tasks". In a principal component analysis, all eight items loaded clearly on one component, thus the two scales were averaged to obtain one team performance measure (α = .90). Instructors rated the extent to which they agreed with the statements on a Likert scale, ranging from 1 (not at all) to 7 (absolutely).

Control Variables. We followed the conceptual framework on the compositional impact of team diversity on team performance by Horwitz (2005) for the selection of control variables. In her model, Horwitz (2005) integrated current theories and models of team diversity and team performance (at that time) into a framework, hypothesizing direct effects of job-related diversity such as functional expertise, education, or tenure, and bio-demographic diversity such as age, gender, ethnicity on team performance. Thus, we controlled for gender, and age as demographic team diversity indices, and for course study and semester term as job-related diversity indices. Demographic diversity effects were operationalized using the Blau index for gender diversity and course study (Blau, 1977). Standard deviations within the teams were used as an index for team diversity for age and

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[9] We excluded item #6 "No one on this group would deliberately act in a way that undermines my efforts", as participants reported having difficulties rating how frequent this behavior occurred since the last meeting.

semester term (Harrison et al., 2002).

Further, the Horwitz' (2005) model considers moderating effects of team type, team size, task complexity, interdependence, and frequency and duration of interactions on the relation of team diversity and team performance. Due to the organizational background of our study, the other variables were constant between the participating research teams. For instance, teams had to abide to the time schedule, with regular team meetings and fixed deadlines, determined by the instructors.

7.3   Results

7.3.1   Agreement Between Team Members and Data Aggregation

In a first step, we calculated agreements between team members to test for the nested data structure. To test agreements between team members, we calculated intraclass-coefficients *ICC(1)* and *ICC(2)*. The *ICC(1)* indicates variance explained by team membership, and *ICC(2)* the extent to which the team's mean rating is reliable, taking into account average team size (Bliese, 2000; Grawitch & Munz, 2004). High and significant *ICC* values were observed for psychological safety, indicating high agreements within teams and differences between teams: $ICC(1)_{T1} = .22$; $ICC(1)_{T2} = .34$; $ICC(1)_{T3} = .25$; and $ICC(2)_{T1} = .49$; $ICC(2)_{T2} = .64$; $ICC(2)_{T3} = .52$). Then we aggregated variables on a team level and examined correlations between psychological safety, team performance, and other control variables. All analyses were conducted on the team level and not in a mixed model, because team level was the analysis of interest and the outcome instructor-rated team performance is only available on team level. All correlations are displayed in Table 10.

7.3.2   Clustering Changes of Psychological Safety Within Teams

Our calculations are based on the intra-team longitudinal approach developed by Li and Roe (2012). We focused on changes within one particular interval, namely from the beginning to midpoint (T1 – T2; first half), thereby controlling for changes from midpoint to the end (T2 – T3; second half; Gersick, 1988). Thus, we clustered changes as follows: First, we mean-centered psychological safety at each time point. Then, we calculated 95% confidence intervals for the mean differences (T2 – T1, and T3 – T2). Thus, we classified the differences as no significant change, increase, or decrease. For instance, the difference in team members' ratings in the first phase (T2 – T1) could lie within the 95% CI, which

means that there was no significant change. Another team could have a difference that lies outside the 95% CI borders. Thus, if the difference was above the upper border of the interval, we coded changes as an increase, whereas when the difference was below the lower border, we coded changes as decrease. Clusters of changes were coded as -1 = decrease, 0 = stable, and 1 = increase. We clustered change patterns in the first half and in the second half in one step. This way, reference values for change were identical. Because our theoretical elaborations stresses changes within the first half, we did not test for the effects of nonlinear changes across the entire team project, but tested separately for the effects of changes of team psychological safety within each half on team performance. Results showed an increase in 22 teams, stability in 18 teams, and a decrease in 19 teams in the first half of the project; and an increase in 23 teams, stability in 18 teams, and a decrease in 18 teams in the second half of the project (Figure 6).

7.3.3 Correlations Between Psychological Safety Trajectory Clusters and Team Performance

Next, we analyzed intercorrelations between all measurement points of team psychological safety, change patterns of psychological safety, team performance, and the control variables team size, team diversity in gender, age, study course, and semester term (Table 10).

Psychological safety assessments showed high and significant intercorrelations; the more teams assessed their team to be psychologically safe at one measurement point, the higher they rated it at a later point. Teams' psychological safety ratings were significantly related with instructor-rated team performance at all measurement points; the more team members perceived their team to be psychologically safe at the beginning, midpoint, and the end, the better the instructors assessed the team performance to be.

Regarding the control variables, only diversity in tenure was significantly associated with team performance. As such, the more diverse teams were regarding their semester term, the lower instructor rated team performance. Further, the more diverse team members were in their semester term, the less psychologically safe they perceived their team to be at all measurement points. The more diverse team members were in age, the lower they assessed the frequency of team psychological safety at the beginning and at the end. Team size was not related with team performance.Thus, we did not include it in our final calculations. Changes of psychological safety in the first half of a project were negatively related with changes in the second half. The more psychological safety ratings increased from beginning to midpoint, the more it declined from midpoint to end.
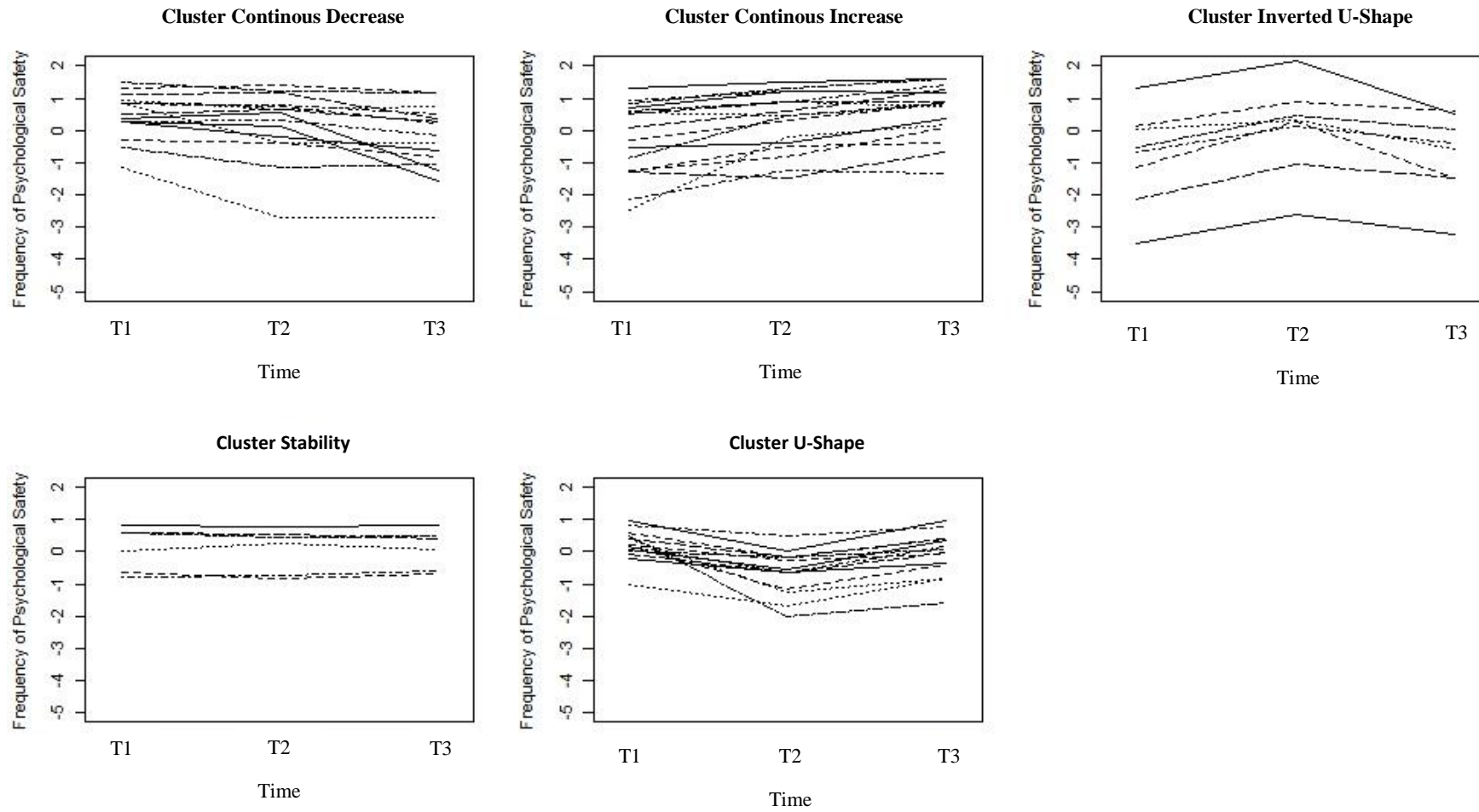
Figure 6. Team Trajectories of Psychological Safety for the 1st and 2nd Half of the Project of 59 Teams.

Table 10

Means, Standard Deviations, and Correlations among Psychological Safety at Three Measurement Points, Changes of Psychological Safety, Team Performance, and Diversity Indices on Team Level

Variable	M	SD	0.1	0.2	0.3	0.4	0.5	1	2	3	4.1	4.2
Team diversity indices (T0)												
0.1 Team size	3.9	.28										
0.2 Gender diversity, Blau's index	.24	.22	-.06									
0.3 Age diversity, s.d.	2.22	2.74	-.40*	.13								
0.4 Study course diversity, Blau's index	.18	.20	.13	-.01	-.12							
0.5 Semester term diversity, s.d.	.36	.60	.04	.17	.22	.11						
Process variables and change indices												
1 Psychological safety, T1 – Beginning	4.19	.37	.11	.07	-.25*	-.14	-.30*					
2 Psychological safety, T2 – Midpoint	4.16	.39	.04	-.08	-.14	.02	-.27*	.69*				
3 Psychological safety, T3 – End	4.14	.38	.07	-.19	-.35*	.06	-.33*	.66*	.79*			
4.1 CL 1st half			-.05	-.29*	.13	.09	.10	-.28*	.37*	.17		
4.2 CL 2nd half			-.04	-.15	-.33*	.10	-.20	-.02	-.27*	.27*	-.33*	
Outcome (T4)												
5 Instructor-rated team performance	5.66	1.00	.03	.03	-.18	.13	-.34*	-.33*	-.42*	.46*	.07	.16

Note. * $p < .05$, $N = 59$ teams, CL = clusters of changes of psychological safety were coded as follows: decrease = -1, stable = 0, and increase = 1.

7.3.4 Initial Levels and Changes of Psychological Safety Predict Team Performance

We used linear regression analysis in R (R Development Core Team, 2012) to predict instructor-rated team performance. Results are displayed in Table 11.

First, we tested a baseline model (Model 1) by including control variables gender, age, semester, and study course diversity. The adjusted R^2 was .10 with a significant fit ($F(4,54) =$ 2.63, $p = .04$). We found that semester term diversity was negatively associated with team performance such that high semester diversity was associated with lower instructor team performance rating. All other control variables did not predict team performance.

Second, we tested the hypothesized main effects in Model 2 by adding the focal predictors initial levels of psychological safety, and changes of psychological safety assessments in the first half of a project to the model. Clusters reported in the table are interpreted in comparison to the decrease cluster. Because changes in the first and second half correlated with each other, we controlled for effects of changes in the second half of a project. The adjusted R^2 was .21 and Model 2 showed a significant fit ($F(9,49) = 2.69$, $p = .01$). Initial levels of psychological safety, and changes in the first half of a project, significantly predicted instructor-rated team performance. Higher initial levels of team psychologically safety were associated with better instructor performance ratings. This finding supports Hypothesis 1. In addition, performance ratings were significantly better for teams, in which psychological safety levels increased or remained stable in the first half of the project, compared to teams in which psychological safety levels decreased. This finding supports Hypothesis 2. Model 2 shows a significant increase in explaining variance in team performance compared to Model 1 ($F(5, 49) = 2.45$, $p = .046$).

Third, we tested for an interaction of the changes in the first and second half of the project, because of the observed correlation. The interaction term was non-significant and the model had no significant better fit compared to Model 2 ($F(13, 49) = 1.93$, $p = .18$).

7.4 Discussion

The main aim of this study was to gain valuable insights on the dynamic nature of psychological safety, and the unique influence of changes of psychological safety on team performance. We found that team performance was dependent on both initial levels and changes of psychological safety within the first half of a project. When psychological safety was high at the beginning and when it increased or remained stable in the first half of the project, teams performed better than when psychological safety was low or decreased.

Table 11

Linear Models Regressing Z-Transformed Changes of Psychological Safety Assessments in the First Half and Second Half of a Project on Instructor-Rated Team Performance on Team Level

Variable	Model 1	Model 2	Model 3
	β	β	β
Control variables			
Gender diversity, Blau's index	.11	.21	.19
Age diversity, s.d.	-.10	-.05	-.00
Study course diversity, Blau's index	.16	.12	.10
Semester term diversity, s.d.	-.36*	-.28*	-.25†
Initial levels and changes[1] of psychological safety			
Initial levels of psychological safety		.32*	.38*
CL 1st half, increase		.41*	-.14
CL 1st half, stable		.36*	.04
CL 2nd half, increase		.68†	-.35
CL 2nd half, stable		.01	-.05
CL1st half increase x CL 2nd half stable			1.20
CL1st half stable x CL 2nd half stable			.11
CL1st half increase x CL 2nd half increase			1.36
CL1st half stable x CL 2nd half increase			.92
Adjusted R²	.10*	.21*	.17

Note. $p < .05$, † $p < .1$, $N = 59$ teams. [1] R provides a significance test for increasing and stable patterns compared to a decreasing pattern. We calculated standardized regression weights by using the the package yhat.

First, our findings support the robust link between absolute levels of psychological safety and team performance (Edmondson & Lei, 2014). Initial levels of psychological safety predicted team performance, in accord with the theory of team coaching (Hackman & Wageman, 2005). The beginning of a project is often characterized by ambiguity and insecurity. Thus, team members are sensitive for cues to reduce this state. Our findings showed increased team perception of psychological safety in the beginning was associated with higher rated performance.

Second, our findings contribute to team research by examining the unique influence of changes in team psychological safety on team performance embedded in a temporal, more holistic

theoretical framework. We extend cross-sectional studies on the relevance of absolute levels of psychological safety for team performance to a longitudinal setting of team research, by including time in our theoretical elaborations and hypotheses testing. Above and beyond absolute (initial) levels of psychological safety, *the changing process* of psychological safety *in the first half of a project* is an important predictor of team performance. The performance of teams with an increasing pattern during this phase were rated as the best, followed by teams with a stable pattern, and finally teams with a decreasing pattern of change. These findings are in line with the main theoretical idea that psychological safety enables employees to cope with changes in their work environment (Schein & Bennis, 1965). An increase or stability of psychological safety during the first phase of a project would empower the group to engage in a fruitful debate to pass the relevant transitions around midpoint (Chang et al., 2003; Gersick, 1988).

An early increase of psychological safety could reflect a team's process of growing together. Thus, team members may comfort each other by providing more signals of psychological safety such as eye contact, long speaking sequences, and concrete invitations to share knowledge or concerns. Similarly, in teams with a stable trajectory during the first half of a project, team members may send a comparable set of signals indicating psychological safety during the meetings. As such, team members might be interested in keeping the level constant but do not experience the need or feel invited to create a safer base for critical exchange. A decrease in levels of psychological safety may indicate one or more team members challenged views and learned that one or more team members were not ready to exercise critics or discuss divergent opinions. A second possibility is that team members perceived their team as less psychologically safe because actions that demonstrate psychological safety were missing. Still, these teams did not need to feel psychologically unsafe. In sum, even small changes in the first half of a project have a strong impact on team performance.

Third, our findings contribute to team research by demonstrating the value of using the intra-team longitudinal approach, and thus consider the teams' history of psychological safety (Li & Roe, 2012). To our knowledge, there are only three studies published so far using this method (Li, Jehn, & Roe, 2016; Li & Roe, 2012; van der Haar et al., 2015). Our method allows a deeper understanding into changing processes of teams, in linear and non-linear temporal dynamics. Our findings suggest that changes throughout within the first half of a project are important for team performance, independent of changes that follow in the second half of the project. Team performance was rated the highest in teams with increasing patterns of psychological safety during the first half of the project, and teams with stable psychological safety patterns out-performed teams in which psychological safety decreased from the beginning until midpoint.

7.4.1   Limitations and Future Research

The intra-team longitudinal approach is based on the concept of "temporalism", the idea to "empirically examine relationships of temporal dynamics of multiple team inputs, processes, and outputs" (Li & Roe, 2012, p. 743). The method allows testing changes over time in a longitudinal design, with respective benefits and limitations. It considers differences in teams' individual interaction histories, linking them to an outcome of organizational interest. Thus, we do not compare high and low performing teams as suggested by the inter-team approach (Li & Roe, 2012). Instead, team trajectories function as a predictor for team outcomes, allowing to draw concrete conclusions about what happened when in the teams. As such, we are able to conclude that teams with an increasing or stable pattern of psychological safety in the first half of a project out-perform teams with a decreasing pattern. Furthermore, this method focuses on different patterns of changes, and not an averaged trend of change, as this is the case in growth or mixed effects curve models where changes are used to predict changes in the outcome (Bliese & Ployhart, 2002). Therefore, conclusions are more specific in regards to *what* happens *when* in the teams and thus implications are individualized. This method aggregates assessments on team level, and thus loses the power of the individual or time level for each measurement point. However, the common method bias is avoided, as we do not need to relate multiple measurement points of the same construct with one another. With 59 teams in total, our *N* group level is satisfactory, and the team members' agreements (*ICC*s) allowed aggregating psychological safety perceptions on group level. We focused on changes in teams and its influence on team performance, however, it is possible to examine differences within teams, such as individual trajectories of psychological safety perceptions, especially if subgroups form and if single individuals or teams report to feel specifically unsafe (Lau & Murnighan, 2005; Roussin, MacLean, & Rudolph, 2016). Thus, changes of psychological safety can be examined and conceptualized on multiple levels.

We measured team psychological safety via self-assessment and linked team perceptions to instructor-rated performance. The response scale was changed from rating the extent of psychological safety to rating the frequency in order to better map possible changes. Further, team members needed to recall more concrete situations to answer the questions, than just rely on a rather diffuse feeling of psychological safety. Further, we did not ask instructors to rank the team output, but to assess the teams' effectiveness by asking if the group was effective and met deadlines. The link between psychological safety trajectories and team performance may be therefore perceptual. For future studies, we recommend to use further output criteria, such as rating the written reports. Furthermore, it would be valuable to investigate psychological safety as a network, or to observe teams and to code behaviors that reflect psychological safety such as eye

contact, body distance, and laughter.

One limitation of our study concerns the project teams we investigated. Thus, the generalization of this study's results is limited to research teams that are rather homogenous in the composition, and less experience to work in teams. Thus, future studies need to replicate the findings in different contexts and team settings. However, the teams fulfill the requirements of interdependency and we could almost map all teams' life cycles completely, which is rarely possible or manageable in other contexts in which psychological safety plays an important role as well. Thus, our study shows the relevance of changes in perceptions of psychological safety, and we encourage researchers to examine temporal dynamics of psychological safety in future studies and to replicate this study's findings in more naturalistic settings or in different organizational contexts.

7.4.2   Practical Implications

When teams start a project, the beginning is particularly important to set a positive norm so that team members feel welcome to take interpersonal risks. Thus, clear signals of psychological safety should be sent within the first meetings, for instance by asking for contributions, or stressing a climate of tolerance regarding learning from mistakes as it increases team performance. The team leader or/ and members can directly invite each other to share ideas or concerns, and leaders can provide room for those exchanges in their meetings. When members demonstrate behaviors that welcome risk taking, it is important for this message to be congruent in words and deeds to be credible (Nembhard & Edmondson, 2006).

In addition, we found that teams with positive changes in the first half out-performed teams with stable and with decreasing patterns. Thus, we recommend fostering the formation psychological safety within the first phase of a project by repeatedly explaining the purpose of conflicting opinions, and by setting up conversation rules that help separate productive factual input from unproductive and personal evaluations. Teams can build on a reliable basis to engage in task conflict and reach consensus to jointly follow their goals. According to the theory of team coaching (Hackman & Wagemen, 2005), there are three important time points when the group is more likely to accept input from the outside; the beginning, midpoint, and the end. Our findings relate to the time between beginning and midpoint, thus an intervention at midpoint may be too late to enhance psychological safety. We recommend training leaders how to build and foster a climate of psychological safety. Further, leaders might refer to interventions from conflict trainings stressing the importance of explaining one's own convictions rather than just to hold on to a specific position for team effectiveness (Innami, 1994).

7.4.3   Conclusion

We followed the temporal approach of team research and demonstrated the relevance of examining changes of psychological safety patterns for an effective team project. We enrich team research by treating teams with respect to their individual developmental histories of psychological safety perceptions, emphasizing high initial levels and the formation of psychological safety, particularly at the beginning of a project for productive teamwork.

8   General Discussion

8.1   Summary and Integration of Findings

Psychological safety is a group phenomenon per definition. Yet, researchers have just begun to examine dynamics of psychological safety calling for the inclusion of time in team research in general, and in research on psychological safety in particular. In this dissertation, I conceptualized psychological safety as dynamic process and focused on dynamics of psychological safety. This work provides the following insights: First, belonging to a specific subgroup is associated with inter-individual differences in team members' perceptions of psychological safety under certain conditions (Study 1 about subgroup dynamics of psychological safety). Second, time and group diversity attributes explain dynamics in the development of psychological safety (Study 2 about the development of psychological safety). Third, relative changes of psychological safety had an impact on team performance above and beyond absolute levels (Study 3 about how temporal dynamics of psychological safety affect team effectiveness).

Altogether, these studies demonstrate the value of including time in the investigation of team psychological safety, a much-needed perspective in team research.

Thus, this work identified a boundary condition of psychological safety, namely subgroup belonging (Study 1). Furthermore, this work sheds light on former inconsistent empirical findings on the effects of *subgroup belonging*, and *demographic faultline strength* on perceptions of psychological safety (Studies 1 and 2), as well as regarding the *development of psychological safety* (Study 2). In addition, this dissertation contributes to research on psychological safety by provinding findings on *group-bounded antecedents for the formation and development*, namely group diversity in terms of the deep level attributes team attitudes, abilities, and personality (Study 2). Moreover, this work is the first to investigate the unique *effects of changes of psychological safety* on other outcomes such as team performance (Study 3).

To put the findings into perspective, I discuss their meaning with respect to the theoretical approaches on which this work builds, thereby addressing former findings and restrictive conditions of these studies in order to integrate the findings. Furthermore, I address the insights gained by the temporal approach by discussing the studies' unique contributions.

Subgroup Belonging, Task Conflict, and Psychological Safety. To begin, we found that belonging to the subgroup that includes the leader was an important moderator for the relation between task conflict and psychological safety (*Study 1*). This finding is in line with Leader-Member-Exchange theory, as in-group membership is associated with more benefits such as higher relationship quality, and more exchange of resources (Graen & Uhl-Bien, 1995).

According to the contingency model of conflict (Bradley et al., 2015), teams benefit from task conflict under certain conditions. Thus, belonging to the leader's in-group is one such condition. Contrary to findings by Burris et al. (2009), we did not find a direct impact of subgroup belonging on perceptions of psychological safety in our study. I refer to two explanations for thess findings. First, as we embedded research in a contingency model of conflict, subgroup belonging does not affect psychological safety perceptions at any point in time, but in situations when the team is faced with critical incidents such as high task conflict. The model of group faultlines (Lau & Murnighan, 2005) supports this interpretation. Accordingly, subgroup structures might affect team processes without being salient (as shown by Burris et al., 2009), or/ and if team members are aware of them, for instance because, **subgroup belonging is a resource that becomes salient in specific situations** such as when task conflict is high (as shown in Study 1 of this dissertation).

Second, the operationalization of in-group and out-group membership could provide further explanations. In two experimental studies, Burris et al. (2009) operationalized the in-group as two friends and the out-group as two strangers (who were confederates in an experiment), whereas in a third field study, they asked supervisors to rate how much they liked their subordinates as an index of closeness. However, we used the faultline algorithm to identify demographically homogeneous subgroups including or excluding the leader. Thus, we identified subgroups due to objective differences regarding gender, age, and tenure compared to a subjective assessment of liking. Our method relies on a dyadic approach evaluating similarities between leaders and subgroup members, whereas asking the supervisor (but not the respective employees) is a one-sided method and does not capture the relational phenomenon of Leader-Member Exchange (Grean & Uhl-Bien, 1995).

As evident from results of our study and other researchers findings, subgroup belonging affects perceptions of psychological safety directly, as well as in specific situations as they become more salient for team members.

The Effects of Faultline Strength on Psychological Safety. Demographic faultline strength was negatively associated with psychological safety (Study 1), more precisely at the point of formation (Study 2, effects of both studies were marginally significant). These findings are the first to **support the model of group faultlines** proposed by Lau and Murnighan (2005). Accordingly, team members in groups with strong faultlines experience **stronger identity-threat** by other subgroup(s) leading to reduced psychological safety perceptions in the entire team. As a consequence, communication processes, information sharing, and risk-taking appears to be easier within the respective subgroup, whereas information exchange across subgroups is associated with negative anticipated reactions. This way, an "us vs. them"- attitude develops in the team.

Apparently, our findings are consistent with the theory, demonstrating that demographic faultline strength was related to psychological safety indicating that strong-faultline groups have disadvantages right from the start (Study 2) as well as later on (Study 1).

Yet, these findings are inconsistent with first results provided by the authors of the model of group faultlines (Lau & Murnighan, 2005). In an experimental study, the authors differentiated between strong- and weak-faultine teams based on team members' ethnicity and sex, and found that same-sex and same-ethnicity team members evaluated their subgroups more favorable in terms of more positive affect and process ratings. This first finding supported their propositions of the mdel of group faultlines. Furthermore, they found a positive association between faultline strength and psychological safety.The authors argue that

> these unexpected findings may have resulted from generalizations of the positive social effects within strong-faultline subgroups to the entire groups, reflecting the importance of proximal relationships; or they may have resulted from other, unmeasured, influences" (Lau & Murnighan, 2005, p. 654).

Put differently, high subgroup levels of psychological safety spread over to the entire group. This is still difficult to integrate in current the current model of group faultlines, because identity threat should still be present. Further on, the authors argue that a joint goal, or common enemy could minimize threat and unite groups, as suggested by Sherif and Sherif (1953). Thus, a further plausible explanation might refer to the context of the task, more precisely, to team members' high interdependency in completing the task. The study took place in a business course, and the task was to analyze the case of a real estate company that had several obstacles to overcome in the past. The teams presented their elaborations on reasons for the failure of the companies at the end of a business course. Thus, group members needed analytical skills, thorough research skills, as well as presentation and writing skills to complete the task (= common goal). More importantly, groups might have competed against each other in the course (= other groups are a kind of enemy) that helped to overcome the proposed negative effects of subgroup building on psychological safety. Because business courses such as simulation games include the direct competition with the other participating teams. Thus, it is plausible that these teams enjoyed competing with other teams in the context of this study as well.

The Formation and Development of Psychological Safety. Teams started with rather high initial levels of psychological safety decreasing across time. We expected high initial levels, thus, this finding is in line with findings from trust research (Lewicki et al., 2006). Individuals seem to give interaction partners a leap of faith during interactions at an early stage of teamwork. The finding on the development of psychological safety is in line with the results presented by Schulte et al. (2012) from consulting teams. As evident from our findings, **time was the strongest**

predictor for the development of psychological safety, over and beyond demographic group diversity, faultline strength, and group diversity. We proposed that time pressure induces a need for closure (Pierro et al., 2003). Thus, groups might have closed themselves off from further feedback in order to focus on their goals - which is reflected in a reduction of psychological safety levels. However, this finding is inconsistent with former findings in innovation teams (Edmondson & Mogelof, 2005). Therefore, I would like to provide a further explanation of Edmondson's findings. I argue that the reason for the stability in psychological safety levels lies in the study's context, more precisely in the task itself. As such, behaviors associated with psychological safety such as addressing original and unconventional ideas or addressing problems in order to solve them *is* included in the task definition of innovation teams. Further, innovation techniques such as brainstorming include certain rules such as not evaluating the others input, or appreciating any kind of feedback.

Altogether, Study 2 contributes to integrating the inconsistent findings on the development of psychological safety, because 1) we provide a theoretical framework on the effects of time on psychological safety, 2) we are the first to test for the effect of time on the development of psychological safety by examining changes by the means of a more sophisticated analyses such as growth curve modelling, and 3), our findings are in line with reports by Schulte et al. (2012), whereas the inconsistent finding by Edmondson and Mogelof (2005) migt be sufficiently explained by task constraints.

Deep Level Diversity Attributes Predict the Development of Psychological Safety. We found that attitude towards teamwork is an important antecedent for high initial levels of psychological safety. Thus, we replicated the positive relation found by Ulloa and Adams (2004) on team level: The stronger a team's attitude towards teamwork was, the higher were initial levels of psychological safety. Further, we found that attitude towards teamwork had a marginal effect on growth of psychological safety over time. This finding could be an indicator that attitudes towards teamwork important for the development of psychologiscl safety as well. This interpretation is supported by Bell's (2007) consideration on similar constructs, namely team collectivism, and team preference. She argued that team collectivism, a rather stable tendency and national-level variable, is positively associated with collaboration processes, because team members with a collective orientation prefer procedures that foster harmony and solidarity (Earley & Gibson, 1998). Further, the preference for teamwork (whether individuals generally prefer teamwork over autonomous work) is linked to productive cooperation processes (Jung & Sosik, 1999). Yet, the proposed model remains to be tested in future studies.

Furthermore, we found that teams high in task-specific skills reported a decrease in perceptions of psychological safety, and teams high in conscientiousness reported an increase

over time. Both attributes (on a team level) have been found to be important resources for team performance (Bell, 2007; Innami, 1994). Yet, teams with high abilities have been found to communicate in a position-oriented way reducing perceptions of psychological safety, which is in line with our findings. Altogether, our results are the first to demonstrate that the rather **variable conctruct of attitudes towards teamwork** (because it is defined as state by Krug, 1997) predict initial levels of psychological safety, whereas team abilities and team personality predict changes of psychological safety over time (Study 2).

The Effects of Changes of Psychological Safety on Team Performance. Finally, this work is the first to address the unique effect of changes in psychological safety on team performance. Following the temporal approach, more specifically the punctuated equilibrium model of group development (Gersick, 1988), we zoomed into two phases of project work, namely the first half, dn the second half. Our findings supported our propositions: In addition to high initial levels of psychological safety, relative changes in the first half of project work predicted team performance. Thus, even small changes of psychological safety were associated with higher performance evaluations from instructors. In the final step of our calculations, we tested for the interaction of changes of psychological safety in the first half and changes in the second half. Results showed that the combination of changes did not significantly predict team performance, and that this model did not explain teamperformance significantly better compared to the previous model. This additional analysis demonstrates the importance of the time window chosen for the analyses and the theoretical reasoning for the investigation on changes over time – as noted by Roe et al. (2012). In summary, these findings highlight the value of the temporal approach to deepen our understanding on the development of team processes, and in particular, for psychological safety. This way,we broaden the validity of the link between psychological safety and team performance from a cross-sectional setting to a longitudinal setting thereby demonstrating the **value of relative changes above and beyond absolute levels** of psychological safety for team effectiveness.

8.2   Theoretical Implications

The current research offers several important contributions to the extant body of literature on psychological safety. The research of psychological safety has been limited to examining this construct rather as antecedent, mediator, or moderator, than as important outcome itself. I focused on psychological safety as outcome (studies 1 and 2). Also, I conceptualized psychological safety as dynamic group process in all three studies. So far, inter-individual dynamics as well as changes

over time have been largely neglected in previous research (Newman et al., 2017; Edmondson & Lei, 2014). Thus, each study presents unique contributions

First, I examined **boundary conditions** of psychological safety showing that belonging to the leader's in-group (vs. an out-group) buffered the negative effects of critical incidents such as task conflict on team members' perceptions of psychological safety (Study 1). Thus, this study explicates contingency variables that explain the interplay of variables on different levels (e.g., subgroup belonging on an individual level, and task conflict on a team level).

Second, I developed a **theoretical framework** for the formation and changes of psychological safety thereby addressing the dynamic nature of psychological safety (Study 2). This study is the first to test for the effects of faultline strength on the formation of psychological safety, and our finding supports theoretical considerations of the model of group faultlines bearing practical implications for team researchers and practitioners.

Third, research on antecedents of psychological safety was limited to leader characteristics and team characteristics such as social resources, e.g., friendship or social networks, diversity in expertise etc. (e.g., Brueller & Carmeli, 2011; Carmeli, 2007; Carmeli & Gittell, 2009; Martins et al., 2013; Schulte et al., 2012). I expanded research about the antecedents of psychological safety by focusing on **what group members bring into the group**, testing for the effects on the dynamics of psychological safety (Study 2). As such, I focused on group diversity, more precisely surface-level diversity regarding gender, age, and tenure, and deep-level attributes regarding values, abilities, and personality, as predictor for the formation and changes over time.

Fourth, I follow the paradigm shift in team research by focusing on temporal changes in psychological safety on team effectiveness (Study 3). Embedding the research in the temporal approach (Roe et al., 2012), more specifically into the group development theory by Gersick (1988), I develop a theoretical model of how and why changes in psychological safety within teams should affect team performance. Further, I provide empirical evidence for the assumptions by demonstrating the relevance of understanding psychological safety as changing process, because changes themselves have a unique influence on team processes above and beyond absolute levels in psychological safety. A short overeiw on the unique contributions of the current research is listed in Tabel 12.

Table 12

Unique Contributions of the Current Research

	Contribution Domain	
	Advancement of Psychological Safety as Dynamic Concept	Advancement of relations of Psychological Safety
Study 1	Examine neglected aspects regarding inter-individual differences of psychological safety perceptions	Subgroup belonging (subgroups included or excluded the leader)
Study 2	Psychological safety starts at relatively high initial levels and decreases over time in project teams (with a clear beginning and deadline)	Faultline strength, time, demographic group diversity, deep level attributes: attitudes toward teamwork, task-specific skills, team personality
Study 3	First to examine changes of psychological safety over time, and the unique effect of changes on team performance	Temporal Approach, Compositional Impact of Team Diversity on Performance
Dissertation	Develop and test a theoretical framework on the dynamics of psychological safety	Examining inter-individual dynamics, antecedents of dynamics over time, and dynamics as predictors for team effectiveness

8.3   Strength and Limitations

Strengths. The first and major strength of the current work is the dynamic conceptualization of psychological safety in all three studies. In Study 1, I focused on inter-individual dynamics of psychological safety due to subgroup belonging. In Study 2, I focused on antecedents for the development of psychological safety. In Study 3, I tested the effects of changes of psychological safety on team effectiveness. Thereby, I built on often-studied leadership approaches such as LMX theory to examine individual differences due to subgroup belonging (Study 1). Next, I developed a theoretical framework on the temporal dynamics of psychological safety based on previous research. I referred to trust research and diversity research,

more specifically to the model of group faultlines by Lau and Murnighan (2005), in order to build propositions on the formation of psychological safety (Study 2). Further, I referred to Gersick's (1988) punctuated equilibrium model of group development and integrated findings regarding the effect of time pressure on group phenomena (cf. need for closure by Pierro et al., 2003) in order to build a framework on the development of psychological safety in project teams (Study 2). Finally, I considered the history of teams by observing trajectories of psychological safety and testing for their effects on team outcomes (Study 3).

A second strength is that this work sheds light on inconsistent findings, e.g., regarding the effects of demographic faultline strength on perceptions of psychological safety (Studies 1 and 2) and the development of psychological safety (Study 2). This work is the first to test for the effects of group faultlines on the development of psychological safety (Study 2) and it is pioneer to investigate the effect of changes of psychological safety on team effectiveness.

Third, the three empirical studies are characterized by different sophisticated methodological approaches. Thus, psychological safety was conceptualized as multi-level phenomenon and analyzed accordingly on the respective level by taking into account team member agreements (all three studies). I expand previous work by taking into consideration cross-level interactions (Study 1), and by testing changes of team psychological safety in a longitudinal design (Studies 2 and 3) by using growth curve modeling (Bliese & Ployhart, 2002) and the intra-team longitudinal approach (Li & Roe, 2012). The intra-team longitudinal approach by Li and Roe (2012) is still in its infancy, as only two studies are published so far, and in both studies one of the developers of this method is co-author. Thus, we are the first to use this method independently of its inventors thereby demonstrating its value for the research on the dynamics of psychological safety.

Fourth, this work investigated different kinds of teams in the field, namely schools (Study 1) and research teams (Studies 2 and 3). Because psychological safety is rather important for small organizations (Newman et al., 2017), we invited primary schools that were rather small to participate in our survey in order to ensure a basic level of interdependence among members of an organization.

Fifth, a further strength is that I improved the response format in Study 3. Team members did not rate the extent but the frequency of signals regarding psychological safety. This way, they needed to refer to specific situations, e.g., in team meetings, when assessing their psychological safety instead of referring to a general kind of affect, which is associated with the team or teamwork.

Finally, this works is based on more than one source by asking employees or team members as well as leaders and supervisors for ratings.

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Limitations. This dissertation has limitations though. For instance, when examining relations of psychological safety and other variables such as conflict at one measurement point by the same raters, the cross-sectional design and self-ratings lead to problems with common-method variances reducing the generalization of the results (e.g., Study 1). However, as subjective perceptions are sometimes more important, particularly when it comes to critical incidents such as conflicts, referring to the same source might provide insights into inter-individual processes in this case. Furthermore, subgroup belonging was calculated by referring to objective attributes such as gender, age, and tenure. Also, we have data from several teachers in each school (average response rate per school was over 50%), and tested a mixed model, to consider common source variance in the calculations. We created our questionnaire thoroughly before distributing the survey to the schools to reduce common method bias. That means we carefully thought about the position of our questions, the introductory sentences as well as the response format (conflict was asked first, and psychological safety later; conflict referred to the last four weeks, and psych safety to this moment; conflict had a frequency response format, and the extent of psych safety was rated). We also stressed confidentiality and the voluntary nature of participation. In addition, we included information about the aggregation of data per school for feedback and that there are no right or wrong answers. All of these steps are based on recommendations by Podsakoff, MacKenzie, Lee, and Podsakoff (2003), and Chang, Witteloostijn, & Eden (2010). These measures might reduce the concerns associated with the common method variance somewhat.

A further difficulty I encountered in the field were the participant rate per school, and missing values in the teachers' ratings (e.g., gender, age, tenure, conflict, psychological safety). Further, I could not calculate the faultline strength over all members, or identify leader in- and out-groups when leaders did not participate in the survey or did not state their position. Thus, the number of units on individual and group level was lower in the final calculations reducing the study's power immensely. It is nearly impossible to obtain complete datasets of teams in the field. Nevertheless, a replication could address these issues further by using more than one measurement point. Conflict might as well be observed and coded in team meetings. In this regard, a future study might address process conflict as well. Further, subgroup belonging might be measured by additional network ratings of leaders and employees on the quality of relationships in a dyadic approach. Thus, this disadvantage is common for field research. In contrast, we had complete teams in studies 2 and 3 and only few missing values. Thus, findings of studies 2 and 3 are representative for comparable research teams.

A further limitation lies in the context, namely schools vs. research teams. However, we focused on primary schools, where employees need to collaborate in common work tasks, but team members have further unique responsibilities for individual tasks such as presenting a topic in front of the students, or being class teacher as well. Although teachers might not be as

interdependent as innovative or production teams, psychological safety is relevant in small organizations as well (cf. Newman et al., 2017). The findings from studies 2 and 3 are limited in its external validity, and, thus, might be generalized to comparable teams that are composed of members sharing a specific educational background, and are rather homogenous in age, tenure, and team-/work experience. Teams were composed of two distinct courses, namely psychology and physics and psychology. Thus, teams differed in their functional background and this feature was salient because team members knew their own cohorts from the first two semester terms. Thus, a certain degree of diversity existed, which was supported by the marginal effect of demographic faultline strength on group perceptions found in Study 2. Another limitation of Study 2 and 3 is that teams worked relatively independently of the context. For instance, these research teams were not embedded in organizations with specific constraints (i.e., they had no leader with clear reward and coercive power). Further, these research teams had clear boundaries such as their study curriculum. Thus, boundaries were not as blurring as they might be in other kinds of organizations were there are no clear definitions of a task, or work requirements.

In sum, future studies need to replicate the findings in different contexts in order to confirm or specify further constraints and the validity range. For instance, the formation might be differentiated into smaller sections such as before teams start working, the first meeting, second meeting, etc. until midpoint. Observation methods would complement subjective ratings of an intact psychological safety climate in a valuable way. More particularly, a multilevel network approach combined with Edmondson, Bohmer, and Pisano's (2001) observation coding scheme might be used to categorize psychologically safe behavior. This way *unsafe* teams might be better understood and contrasted with safe teams. Furthermore, the subgroup perspective on psychological safety that has been stressed by Roussin et al. (2016) allows diagnosing and testing for combined effects due to inter-individual, subgroup and group dynamics of psychological safety perceptions on team effectiveness.

8.4   Future Directions

Based on the studies' findings, I would like to present further promising avenues to pursue in the field of psychological safety. In particular, I address three aspects: the measurement of psychological safety, the examination of psychological safety dynamics, and the scope of application.

The Measurement of Psychological Safety. It is difficult to compare findings and to do research on psychological safety as methods of measurement vary widely and inconsistencies regarding the original scale's internal validity are reported. Since 1965, researchers are interested

in psychological safety in organizations. Since 1994 researchers provided new scales to measure the construct (Edmondson, 1999; May et al., 2004; Anderson & West, 1994, 1998). Reviews provide evidence for the predictive validity of psychological safety (Edmondson & Lei, 2014; Newman et al., 2017). Yet, there is no validation study, although there are inconsistent reports regarding the TPS scale's internal validity. For instance, internal consistency measure *Cronbach's alpha* ranged between .6 and .7 in several studies (e.g., Gockel, 2007; Kayes, 2006; Mu & Gnyawali, 2003; Van den Bossche et al., 2006). Whereas with higher internal consistency, some studies report a reduced number of items (e.g., 6 items by Baer & Frese, 2003; 4 items by Nembhard & Edmondson, 2006; 1 items by Tucker, 2006). Further, empirical support for the theoretical distinction of psychological safety from similar team processes such as trust in teams would be valuable to disentangle the intertwined relation of these two variables over time.

Further, a comparison of the predictive value of Edmondson's scale, May's items, and Anderson and West's (1994, 1998) subscale of participative safety would provide a guide for researchers which scale is to be preferred over the others, or could be more valuable in a specific research context. There is still a quite diverse use of scales and methods used to measure psychological safety (Newman et al., 2017). However, the suggestion to just use Edmondson's scale is difficult to support without a validation study addressing 1) the internal validity issues, 2) convergent and discriminant validity, and 3) predictive validity of the different psychological safety scales. Further, a validated translation of these scales into different languages would facilitate the comparison of research findings across different countries.

New measurement approaches such as the multi-level approach by Roussin et al. (2016) are developed. Yet, a network approach is not feasable in most organizations, and this approach relies on Edmondson's items (1999) as well. Taken together, a validation study on the scales measuring psychological safety in teams is the first concern future research needs to address.

Considering Psychological Safety As Dynamic Process. Future studies need to conceptualize psychological safety as dynamic concept. A good start would be to include the dynamic aspect in the definition of psychological safety. Thus, I suggest the following expansion of the definition of team psychological safety: Psychological safety is a dynamic process in teams that is reflected in members' shared perceptions if the team is safe for interpersonal risk taking. Further, preliminary analyses about the scale's psychometric attributes (e.g., confirmatory and component principal factor analyses) suggest that psychological safety has not one but two factors that can be described best as affective and cognitive aspects of psychological safety (Schmidt, 2009). This approach is supported by trsut research as well (Lewicki, et al., 2006), because trsut scales measure affective-based trust as well as cognitive-based trust, and further models describe calculative trsut as well. Therefore, I suggest a more refrined analysis on the factor structure of the

TPS scale. Consequently, I repeat the call for a validitation study focusing on the discrimination of psychological safety and trust on a conceptual and methodological level.

As evident from this work, future research on the development and the effects of changes is promising, as changes effect team effectiveness in addition to absolute levels (Study 3) and psychological safety had a natural trend to decrease over time (Study 2).

Thus, future research needs to address which interventions are effective in increasing psychological safety at what point in time. According to an integrated theory of group development (Chang et al., 2003), groups undergo multiple transitions. Besides a crucial transition around midpoint, researchers observed further transition points especially in the first phase of teamwork. These early transitions might be connected to storming processes between team members (Chang et al., 2003).

If an increase of psychological safety towards midpoint is valuable for team performance, but teams are not open for input until midpoint, or shortly before the deadline (and team members may perceive time pressure individually), the question arises how leaders or team coaches might provide assistance for a positive development of psychological safety. In this regard, a dynamic approach for interventions might be applicable as well. As such, intermediate deadlines might be used to initiate further potential transition points (Hackman & Wageman, 2005). These deadlines might open team members' horizon for input thereby highlighting common goals and the evaluation of the team's progress and needs for future task completion. If research is not possible across a team's entire life cycle, it might be valuable to define time intervals, or relate assessments of psychological safety to critical events such as the exit or entry of new team members. Furthermore, observation techniques or sensors-based methods (see Cook & Meyer, in press) evaluating team members' voice, direction of bodies, speaking times with particular team members might add to understand how individuals or subgroups stabilize their climate of psychological safety.

Further, more research is needed to address how changes of psychological safety affect changes of team performance and under what circumstances. Researchers might use the intra-team longitudinal approach, or change models (see Boswell, Shipp, Payne, & Culbertson, 2009 on the effects changes in newcomer job satisfaction over time) in order to integrate team members' history in research and address questions such as how do changes in trust or conflict affect changes in psychological safety and team effectiveness.

Taken together, a more dynamic perspective in research paradigms is needed by including time and changes in theory, research design, and empirical testing.

Scope of Application. The third future direction concerns psychological safety is a potential resource or vulnerability factor at work. Based on the conversation of resources theory

(Hobfoll, 1989), members in psychologically safe teams might enhance their individual resources or prevent own resources from depletion by voicing problems and, thus, fostering quick solutions for critical situations. Further, the climate of psychological safety might foster a climate of authenticity alleviating burnout in health care teams (Grandey, Foo, Groth, & Godwin, 2012) as it might foster the maintenance of mental hygiene procedures. In this context, I claim for a more thorough investigation of the effects of inter-individual or subgroup dynamics of psychological safety over time on burnout considering cross-level effects as well. It might be plausible that a constant decrease in psychological safety in teams or individuals might predict the burnout facet disengagement in addition to absolute levels. Threshold models commonly used in research fields of biology, developmental psychology, formation models of disorders in clinical psychology, etc. support this claim. Accordingly, threshold situations describe changes in an individual's bringing uncertainty and new challenges along (which is in line with the basic idea of when psychological safety is relevant for organizations by Schein and Bennis, 1965). Threshold situations, and thus coping patterns, start early in an individual's life, e.g, with the entry into kindergarden, school, or higher education, as well as into organizations. Further threshold situations might be characterized by multiple challenges that exceed the individual's coping abilities and, thus, cause stress (Lazarus, 2000). This theory might be transferred to team level as well. For instance, a the sudden and unpleasant termination of an important team member might shake psychological safety perceptions of the remaining team members immensely. Thus, the question will arise, what does this team need to become safe again – and for how long? Thus, future studies might address under which conditions, psychological safety is a resource, or when does it become inverse?

8.5   Practical Implications

Practical implications are drawn from the three empirical studies concerning the following aspects: the establishment of high-quality relationships between leaders and employees (Study 1); the reduction of the negative effects of faultline strength and group diversity on perceptions of psychological safety (studies 1 and 2); and the timing of interventions in order to promote growth of team psychological safety (studies 2 and 3).

Establishing High-Quality Relationships. Team members who belong to a demographically homogenous subgroup including the leader were not negatively affected by task conflict in their perceptions of psychological safety. The idea behind this positive effect is based on a stronger attraction between subgroup-members that fosters communication and exchange of resources (cf. LMX theory by Graen & Uhl-Bien, 1995). By establishing high-quality relationships with team members, leaders foster psychological safety beyond demographic

similarities that exist when entering an organization or team. This conclusion is supported by research that stresses the importance of friendship ties and social networks as resources at work (e.g., Carmeli, 2007; Schulte et al., 2012). However, this study also stresses the importance of considering naturally emerging subgroup structures for effective teaming.

First of all, it is important for leaders to explicitly and constantly send the clear message to team members, or new members entering the team, expressing a strong interest in establishing good working relationships. This is important because the subtext included in this message is: "I am interested in working with you. From my perspective - all of you belong to my in-group."

Further, leaders should be **aware of the subgroup structure in team situations**. To prevent falling into individual patterns of how the leader as private person might make contact to others, leaders might routinize procedures such as to start team meetings by taking a look around, briefly staying on every member. This is important, because the establishment of eye-contact (but not starring) is the basis for the further development of a relationship and individuals more likely respond to nonverbal signals as compared to verbal signals (Jacob et al., 2013). Furthermore, leaders should pay attention to the involvement of all team members, especially in critical team situations, when subgroup belonging might gain in salience. Thus, leaders might invite team members that did not yet participate in the discussion, separately by an impersonal phrase (but not directly) such as "Does anyone of those who did not express an opinion yet like to add something?". This way, leaders might shift their attention from their "favourates" to those that are not automatically in the leader's sight.

Reducing the Negative Effect of Demographic Faultline Strength. Demographic faultline strength had a negative effect on psychological safety, particularly on the formation of group psychological safety (Studies 1 and 2). Thus, leaders should pay attention to the team's composition in terms of weakening faultlines. This approach would help as team members might profit from interpersonal attraction processes, thereby taking advantages of diversity by reducing the negative impact of emerging subgroups (cf. Lau & Murnighan, 2005). Further, leaders might **match task design and informal communication networks** to current or changing group faultline dynamics such as assigning subtasks to naturally emerged subgroups, or specific individuals.

According to the model of group faultlines (Lau & Murnighan, 2005), leaders need to consider characteristics of the task, communication structures, and team members. More importantly, leaders need to **respect group and subgroup boundaries** that are associated with the observed characteristics (Hornsey & Hogg, 2000), otherwise they "might make mistakes when encouraging the group to closely work together, if the group has a strong faultline" (Lau & Murnighan, 2005, p. 657). Thus, the team would benefit in terms of higher levels of psychological

safety when cross-subgroup communication is reduced, and tasks are in line with within-subgroup inclinations. A forced integration into a bigger group might raise difficulties by creating identity threat and an impaired climate of psychological safety. However, when goal completion becomes important, leaders might **stress common goals,** threats, competition, or deadlines to bring members' attention to the group level and to overcome interpersonal tensions (cf. Robbers' Cave experiments by Sherif & Sherif, 1953). –Yet, leaders might follow Roussin's (2008) suggestions by approaching subgroups or specific individuals in **a one-by-one setting** and not in the group context, as a dyadic-level discovery is psychologically safer and leaders learn more about their followers and are perceived as more consistently effective.

Another means that leaders might consider to overcome the detrimental effects of faultline strength are **pro-diversity beliefs in combination with high task motivation**. In teams whose members valued diversity and were highly motivated, demographic faultline strength did not affect task performance (Meyer & Schermuly, 2012). This might as well reduce the constraining effect of subgroup belonging on the formation of psychological safety (see Burris et al., 2009). Empirical evidence for this suggestion is yet to come.

Further, positive team attitudes toward teamwork and high levels of team conscientiousness contribute to the formation and favorable development of psychological safety. Thus, leaders might pay attention to these attributes when composing teams; or they might set the norm by stressing the relevance of positive attitudes towards teamwork and the value of learning from mistakes or failures for a productive process.

Time-Related Team Interventions. According to the team coaching theory (Hackman & Wageman, 2005), team **interventions should be bound to time**, as teams' readiness for input from the outside is higher at the beginning, midpoint, and the end of a project compared to in-between. Because starting a new task with unknown team members puts individuals in a rather insecure position, team members are searching for signals of psychological safety from the very beginnings of teamwork (Hackman & Wageman, 2005). Thus, the first meeting is crucial for team leaders to set norms (e.g., of performance expectations, expression of conflict) and create an intact climate of psychological safety, e.g., by demonstrating warm welcomes to the team to address problems or issues at hand (cf. concept of leader inclusiveness by Nembhard & Edmondson, 2006), providing work material and resources such as supportive communication structures. Our study stresses the importance of fostering the formation of psychological safety during the early stage of teamwork. Thus leaders need to **encourage team members to challenge each others'** ideas from the start, and especially during early interactions, for the benefit of the projects' success. As we found a trend of psychological safety to decrease over time, we further

recommend to repeatedly reminding teams at midpoint to stay open for input in order to prevent prevent substantial mistakes to happen.

Around midpoint, team interventions focusing on strategic input had stronger effects on team performance compared to an intervention focusing on interpersonal relations (Woolley, 1998). Thus, it is important for leaders and organizations to focus on assisting teams to develop a **task-appropriate performance strategy** or by providing support so that the team might ask a consultant or team coach for help. Because a constructive discussion around midpoint differentiates high-performing teams from low-performing teams, it would be reasonable to provide discussion rules or techniques such as the consensual conflict resolution training (CCR, Innami, 1994) at this point. The CCR has shown to reduce the negative effects of position holding communication behavior on team performance in teams with high resources in terms high task knowledge. This might reduce the negative effect of high task-specific skills on the development of psychological safety that we found.

Finally, a reflection of team work by **evaluating** what went well and what went wrong is recommended after the project is completed (Hackman & Wageman, 2005). This way, team members might transfer their positive psychological safety perceptions to the next project, or unsafe teams, subgroups, or members might be identified. This way, issues might be worked out in order to avoid a spillover on subsequent tasks. In this regard, feedback is important for leaders and the organization to evaluate constraints of the previous work. For instance, the constellation of subgroups and the leader's position within subgroup structure might give insights to *unsafe* teams that help improve teamwork for the future. Thus, the multilevel approach and the team-member-ratings suggested by Roussin et al. (2016) could be used as diagnostic tool. In some cases, leaders could be trained to deal better with specific constellations in the future. This might be the case, if the leader is part of a particularly big or small subgroup, or if the leader is related to one specific team member that is linked to the rest of the team, or if the leader is detached from the team at all. In extreme cases, a leader might as well be substituted, in other cases it might be enough to diagnose in- and out-groups and to pay attention to a rather equal consideration of team members in group situations such as team meetings, or bigger events.

8.6   Conclusion

Psychological safety is a key factor for successful teamwork. It is defined as team members shared perceptions that the team is safe for interpersonal risk-taking. Psychological safety important in a variatey of work settings, an in particular for teams as it is associated with more learning and better performance.

The central meaning of psychological safety for teamwork is in sharp contrast to the existing genesis of knowledge on its formation and development. This is the exact starting point of this dissertation.The current research contributes to previous work by conceptualizing psychological safety as dynamic process. More precisely, the three empirical studies focused on the subgroup dynamics and changes of psychological safety over time.

First, we found that belonging to the subgroup that included the leader (compared to one that excluded the leader) buffered the negative effects of task conflict on teachers' perceptions of psychological safety. Second, we found that group faultlines, so called hypothetical lines that split a team into subgroups based on demographic attributes, had a negative impact on the formation psychological safey. Furthermore, deep- level group diversity predicted the development of psychological safety in research teams. High initial levels of psychological safety depended on team members' positive attitudes toward teamwork. Moreover, changes in psychological safety depended on team members' abilities and their personalities. When team members had high task-specific skills, psychological safety decreased. Whereas when team members were high in conscientiousness, psychological safety increased over time. Third, we found that team performance depended on initial levels and growth of psychological safety in the first half of a project.

Altogether, this dissertation is pioneer work and contributes toward the building of a much-needed dynamic perspective on psychological safety in groups (cf. Newman et al., 2017; Edmondson & Lei, 2014). The findings provide crucial insights into how psychological safety forms and develops deepening the understanding of constraints and enhancement opportunities as well as opening up new avenues for future research.

9   Appendix – R-Script for Cluster-Calculation

```
#Funktion erstellt von Dominik Dilba und Rebecca Gerlach

#wichtig: alle Variablen müssen vollständig sein und die gleiche Länge haben
changedata_cluster.orig <- changedata_cluster
changedata_cluster <- na.exclude(changedata_cluster)

Variable <- changedata_cluster$Ztps6
Zeit <- changedata_cluster$Time
ID <- changedata_cluster$Gruppen_ID

#Gruppen mit fehlenden Werten zu irgendeinem Zeitounkt: 24, 40, 41, 42, 43, 47, 48, 49, 50, 59
loeschen <-
as.numeric(as.character(changedata_cluster.orig$Gruppen_ID[which(is.na(changedata_cluster.orig$Ztps6))]))
loeschen2 <- c()

for(i in 1:length(loeschen))
{
  loeschen2 <- c(loeschen2, which(changedata_cluster.orig$Gruppen_ID == loeschen[i]))
}

changedata_cluster <- changedata_cluster.orig[-loeschen2, ]
changedata_cluster$Gruppen_ID <- factor(changedata_cluster$Gruppen_ID)
rownames(changedata_cluster) <- 1:nrow(changedata_cluster)

Verlauf <- function(Variable, Zeit, ID) {
 #wenn Zeit-Variable kein Faktor ist, als solchen definieren
 if(is.factor(Zeit == FALSE)) {Zeit <- factor(Zeit)}

 #wenn weniger als 2 Zeitpunkte vorhanden sind, abbrechen und warnen
 if(length(levels(Zeit))<2) {print("Fehler: nur ein Zeitpunkt"); return()}

 #Anzahl der Zeitpunkte als n speichern
 n <- length(levels(Zeit))

 #Datensatz bilden
 Daten <- data.frame(Variable, Zeit, ID)
 Daten <- Daten[order(Daten$Zeit, Daten$ID),]

 #alle Differenzen abspeichern in Matrix
 Matrix.Differenzen <- matrix(NA, length(table(ID)), n-1)

 #Schleife, berechnet Differenzen
 for(i in 1:(n-1))
 {
  Matrix.Differenzen[,i] <- Variable[which(Zeit == levels(Zeit)[i+1])] -
    Variable[which(Zeit == levels(Zeit)[i])]
 }

  #Konfidenzintervall für die Differenzen, wobei Mittelwert der Differenzen 0 gesetzt wird
 #Streuung und Anzahl der Werte basiert damit auf Originaldaten, Intervall ist aber auf 0 zentriert
 #-> welche Abweichung vom Anstieg 0 ist signifikant? -> wird zum Clustern verwendet

 Intervallgrenzen <- matrix(NA,n-1,2)

 for(i in 1:(n-1))
 {
  Intervallgrenzen[i,1:2] <- t.test(scale(Matrix.Differenzen[,i], scale = FALSE))$conf[1:2]
 }
```

```
  #print("Grenzen eines 95%-CIs um den Anstieg 0, alles außerhalb hat einen signifikant von 0 verschiedenen
Anstieg")
 #print(Intervallgrenzen)

 #Clusterkennzeichnung
 Cluster <- matrix(NA, length(table(ID)), n-1)

 #alle Differenzen mit CI vergleichen, Anstieg (negativ, nicht signifikant von 0 verschieden, positiv) notieren
 for(i in 1:(n-1))
 {

  Cluster[which(Matrix.Differenzen[,i] < Intervallgrenzen[i,1]),i] <- -1
  Cluster[which(Matrix.Differenzen[,i] > Intervallgrenzen[i,2]),i] <- 1
  Cluster[which(Matrix.Differenzen[,i] >= Intervallgrenzen[i,1] & Matrix.Differenzen[,i] <=
Intervallgrenzen[i,2]),i] <- 0

 }

 #Cluster enthält eine Spalte für jede Differenz, Endresultat soll aber in einzelner Variable stehen
 #erste Differenz abspeichern
 Output <- Cluster[,1]

 #alle weiteren Differenzen anhängen (z.B. "1 1" für zwei bedeutsame Anstiege bei 3 Messzeitpunkten)
 for(i in 2:(n-1))
 {
  Output <- paste(Output, Cluster[,i])
 }
 Output <- list(Intervallgrenzen, Output)

 for(i in 1:ncol(Cluster))
 {
  Output[[2+i]] <- Cluster[,i]
 }

 names(Output) <- c("Grenzen 95% CI", "Cluster")

 print(Output)

}
Output <- Verlauf(Variable = changedata_cluster$Ztps6, Zeit = changedata_cluster$Time, ID =
changedata_cluster$Gruppen_ID)

#wie oft kommen die Cluster vor?
table(Output$Cluster)
```

10   Reference List

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11   Curriculum Vitae

Rebecca Gerlach

Diplom-Psychologin, Gesprächstrainerin für Paare (EPL)

Lebenslauf (Personal Career)

Persönliche Daten

Name:	Rebecca Gerlach, geb. Schmidt
Geburtsdatum:	25.04.1985
Geburtsort:	Dresden
Familienstand:	Verheiratet, 1 Kind

Berufliche Erfahrung

Seit 10/2016	Wissenschaftliche Mitarbeiterin und Doktorandin am Institut für Psychologie an der TU Chemnitz/ Professur für Organisations- und Wirtschaftspsychologie
02/2016 – 10/2016	Stipendiatin an der Professur für Organisations- und Wirtschaftspsychologie an der TUC
04/2010 – 01/2016	Wissenschaftliche Mitarbeiterin und Doktorandin an der Professur für Organisations- und Wirtschaftspsychologie an der TUC
02/2010 – 03/2010	Beratung und Kompetenzbilanzierung im Projekt 50+, QAB in der Sächsischen Bildungsagentur BMG Langer, Zwickau

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Weiterbildungen

Seit 12/2016	In der Ausbildung zum Coach mit System in pädagogischen, sozialen & kirchlichen Handlungsfeldern, zertifiziert nach der DGfC (Deutsche Gesellschaft für Coaching e.V.)
11/2016 – 01/2017	Zertifizierte Trainerin zur Begleitung von Paargesprächen nach dem Manual **E**in **P**artnerschaftliches **L**ernen (EPL), Bistum Dresden-Meißen

Studium

10/2003 – 12/2009	Studium mit Abschluss Dipl.-Psychologin an der TU Chemnitz mit 2-facher Vertiefung Arbeits-/ Organisationspsychologie (A/O) & Klinische Psychologie

Studienbegleitende Praktika und ehrenamtliche Arbeit mit Sozialarbeitern

03/2012	Arbeit als Dolmetscherin und Gruppenteilnehmerin in einem Austauschprojekt mit Sozialarbeitern des Landesjugend-pfarramtes Dresden nach Shanghai, China zur Weiterbildung im Bereich Ausbildung von Jugendlichen im internationalen Vergleich (10 Tage)
01/2009 – 02/2009	Studentische Hilfskraft an der Professur für Wirtschafts-, Org.- und Soz.-psych., Zuarbeit Berichterstellung einer Mitarbeiterbefragung des Fraunhofer Instituts in Chemnitz
04/2007 – 07/2007	Berufspraktikum Rehaklinik Carolabad in Chemnitz
09/2006	Arbeit als Dolmetscherin und Gruppenteilnehmerin in einem Austauschprojekt mit Sozialarbeitern (Rückbegegnung in Zwickau, Deutschland für 7 Tage)
10/2004 – 03/2005	Studentische Hilfskraft an der Professur für Entwicklungspsychologie der TU Chemnitz
09/2005	Arbeit als Dolmetscherin und Gruppenteilnehmerin in einem Austauschprojekt mit Sozialarbeitern des Landesjugend-pfarramtes Dresden in Aberdeen, Schottland (7 Tage)
08/2003	Arbeit als Dolmetscherin und Gruppenteilnehmerin mit einer Gruppe von Jugendlichen (körperlich Behinderte und psychisch belastete Mädchen und Frauen im Alter von 15- 28 Jahren) in Birr, Irland (14 Tage)
09/ 2003	Arbeit als Dolmetscherin und Gruppenteilnehmerin in einem Austauschprojekt mit Sozialarbeitern des Landesjugend-pfarramtes Dresden in Minneapolis, USA (10 Tage)

Schulische Ausbildung

09/1991 – 07/2003	152. Grundschule, Dresden bzw. Bertolt-Brecht-Gymnasium, Dresden

Fähigkeiten/ Interessen

Führerschein:	Klasse B
EDV-Kenntnisse:	Statistikprogramme SPSS (sehr gut), AMOS (gut), HLM (gut), R (gut), Lime Survey (Grundkenntnisse)
Sprachkenntnisse:	Englisch (verhandlungssicher), Französisch & Latein (Grundkenntnisse)
Interessen:	Singen, Gitarre spielen, Fahrrad fahren, Schwimmen, Lesen

Chemnitz, den 24.09.2017

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Rebecca Gerlach

12   Scientific Career

Wissenschaftlicher Werdegang (Scientific Career)

Forschungsinteressen

- Psychologische Sicherheit in Teams/Organisationen (z.B. im Kollegium von Grundschullehrern, Pflegeteams, längsschnittliche Betrachtungen vorrangig in studentischen Teams)

- Konflikte, Führung, und Training von Teams

- Entwicklung von Teamprozessen über die Zeit und die Bedeutung der Zusammensetzung der Gruppe für die Entwicklung

Mitgliedschaft

Seit 10/2010	Deutsche Gesellschaft für Psychologie (DGPs) – Fachgruppe Arbeits-, Organisations- und Wirtschaftspsychologie

Konferenzbeiträge

Organisatorische Tätigkeiten

- Mitglied des Organisationskomitees des Symposiums *Changes in Teams* auf der Conference of the European Association of Work and Organizational Psychology (EAWOP, 2017, Mai) in Dublin, Irland (Gockel, Gerlach, Cook).

- Mitglied des Organisationskomitees des 7. Internationalen Workshop Organizational Participation in Europe Network (OPEN, 2013, September) in Fribourg, Switzerland (Gockel, Gerlach, Brantl).

Vorträge

- **Gerlach, R.**, Gockel, C., & Cook, A. (S.) (2017, Mai). *Changes of psychological safety before midpoint predict team performance.* 18th Conference of the European Association of Work and Organizational Psychology, Dublin, Ireland.

- **Gerlach, R.**, Gockel, C., & Ketzer, J. (2016, September). *Is change of psychological safety and trust related to group performance?* Vortrag auf der 50. DGPs-Tagung, Leipzig, Deutschland.

- **Gerlach, R.** & Gockel, C. (2016, September). *A question of time: Die Zusammensetzung der Gruppe sagt das Anfangsniveau und Veränderung in psychologischer Sicherheit vorher.* Vortrag auf dem 13. Nachwuchsworkshop der DGPS-Fachgruppe AOW-Psychologie, Aachen, Deutschland.

- **Gerlach, R.** & Gockel, C. (2016, August). *We belong together: Task conflict fosters psychological safety when teachers belong to the principal's in-groupbut not to an out-*

group. Vortrag an der SRH Berlin, Arbeits- und Organisationspsychologie, Berlin, Deutschland.

- **Gerlach, R.** & Gockel, C. (2016, Juli). *We belong together: Task conflict fosters psychological safety when teachers belong to the principal's in-groupbut not to an out-group.* Vortrag auf dem 8. Sächsischen Kolloquium der Arbeits- und Organisationspsychologie, Dresden, Deutschland.

- Pragst, C., **Gerlach, R.**, & Zill, A. (2014, September). *The relevance of faultlines in the relationship of psychological safety and error-reporting behavior – A qualitative analysis.* Vortrag auf der 49. DGPs-Tagung, Bochum, Deutschland.

- Brantl, A., **Gerlach, R.** (2014, July). *Believing and sharing from the start? – Development of shared leadership and collective efficacy in work groups and their effect on team performance.* Presentation at the 28th International Congress of Applied Psychology, Paris, France.

- **Gerlach, R.**, Ketzer, J., & Gockel, C. (2013, September). *Does conflict affect Psychological Safety differently – if group members belong to the in or out group of the leader?* Conference of the Organizational Participation in Europe Network, Fribourg, Switzerland.

- Brantl, A., **Gerlach, R.**, & Gockel, C. (2013, September). *Shared leadership and collective efficacy in student teams.* Presentation at the OPEN-conference (participation in organizations), Fribourg, Switzerland.

- **Gerlach, R.** & Gockel, C. (2013, Juli). *Verlaufsanalyse der Psychologischen Sicherheit und Leistung in Projektgruppen.* Vortrag auf dem 5. Sächsischen Kolloquium der Arbeits- und Organisationspsychologie, Dresden, Deutschland.

- **Schmidt, R.**, Gockel, C., Brantl, A. (2013, May). *How psychological safety develops in teams. Team composition predicts initial levels and change of psychological safety in teams.* 16th Conference of the European Association of Work and Organizational Psychology, Münster, Germany.

- Gockel, C. & **Schmidt, R.** (2013). *Trajectories of shared leadership – and not absolute levels – relate to team performance.* 16th Conference of the European Association of Work and Organizational Psychology, Münster, Germany.

- **Schmidt, R.**, Gockel, C., Ketzer, J. & Werth, L. (2012, September). *Der Effekt von Konflikthäufigkeit mit Leitung und Kollegen auf das Erleben der psychologischen Sicherheit in Lehrerkollegien.* Vortrag auf der 48. DGPs-Tagung, Bielefeld, Deutschland.

- Gockel, C. & **Schmidt, R.** (2012). *Extraversion and agreeableness influence constructive and destructive leadership behavior in teams.* 48th Congress of the German Psychological Society (DGPs), Bielefeld, Germany.

- Gockel, C. & **Schmidt, R.** (2012). *Own and others' personality characteristics influence the emergence of leadership behavior in teams.* 7th Annual INGRoup Conference, Chicago, IL.

- **Schmidt, R.**, Gockel, C., Ketzer, J. & Werth, L. (2012, Juli). *Psychologische Sicherheit in Lehrerkollegien- Zusammenhang zur Konfliktwahrnehmung.* Vortrag auf dem 4. Sächsischen Kolloquium der Arbeits- und Organisationspsychologie, Chemnitz, Deutschland.

- **Schmidt, R.**, Gockel, C. & Werth, L. (2010, Juli). *Let's Play it Safe! A Validation Study of the Team Psychological Safety Scale.* Vortrag auf dem 2. Sächsischen Kolloquium der Arbeits- und Organisationspsychologie, Dresden, Deutschland.

Poster

- **Gerlach, R.**, Gockel, C., Ketzer, J., & Meyer, B. (2017, September). *Relative Psychologische Sicherheit schützt vor Burnout bei Pflegekräften.* Poster auf der 10. Tagung der Fachgruppe Arbeits-, Organisations- und Wirtschaftspsychologie, Dresden, Deutschland.

- **Gerlach, R.**, Ketzer, J., & Gockel, C. (2014, September). *Intragroup conflict and psychological safety in teaching staff: Is task conflict differently related to members' perceptions of psychological safety when they belong to the leader's in or outgroup?* Poster auf der 49. DGPs-Tagung, Bochum, Deutschland.

- **Gerlach, R.**, Ketzer, J., & Gockel, C.(2014, July). *Timing matters: Change of psychological safety during the first half of group work - and not the second half - is related to group performance.* Eposter and oral presentation at the 28th International Congress of Applied Psychology, Paris, France.

- Ketzer, J., & **Gerlach, R.** (2014, July). *Closed-minded in chasing the common goal when it gets closer? How does need for closure as group composition feature relate to psychological safety in groups over time?* Eposter and oral presentation at the 28th International Congress of Applied Psychology, Paris, France.

- **Schmidt, R.**, Gockel, C. & Werth, L. (2011, September). *Entstehung und Veränderung von psychologischer Sicherheit in Teams.* Poster auf der 7. Tagung der Fachgruppe Arbeits-, Organisations- und Wirtschaftspsychologie, Rostock, Deutschland.

Lehrtätigkeit

- Soft Skills, Seminare mit Workshopcharakter zu Kommunikation und Führung in Englisch und Deutsch (Bachelor und Master) ab dem SoSe 2017

- Soft Skills, Seminare mit Workshopcharakter zu Kommunikation und Gesprächsführung, sowie Präsentationstechniken (Bachelor und Master) im WiSe 2016/17

- Seminar Selbstregulation (Master) im SoSe 2014/ 2013/ 2012

- Seminar Fehlentwicklungen in Organisationen (Master) im WiSe 2013/14

- Seminar Arbeitsteams in Organisationen (Bachelor) im WiSe 2013/14, SoSe 2013, WiSe 2012/13, WiSe 2011/12

- Seminar Personalauswahl (Bachelor) im WiSe 2012/13, SoSe 2011

- Seminar Führung (Bachelor) im SoSe 2012, WiSe 2010/11, SoSe 2010

Chemnitz, den 24.09.2017

Rebecca Gerlach

13 Eidesstattliche Erklärung

Hiermit erkläre ich, dass ich die vorliegende Arbeit mit dem Titel

Time for a Change: The Effects of Subgroup Dynamics and Time on Psychological Safety

selbstständig angefertigt habe. Es wurden nur die in der Arbeit ausdrücklich benannten Quellen und Hilfsmittel benutzt. Wörtlich oder sinngemäß übernommenes Gedankengut habe ich als solches kenntlich gemacht.

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Rebecca Gerlach

Chemnitz, den 29.09.2017

13 Eidesstattliche Erklärung