Diversity faultlines and team learning

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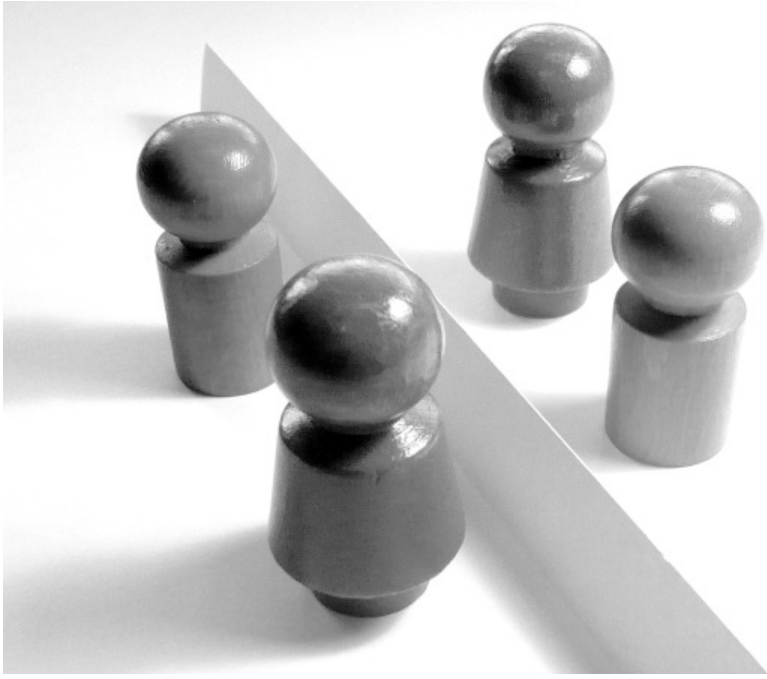
CHAPTER **5**

When Do Faultline and Cross-Categorized Teams Learn?

The Role of Error Culture[1]



[1]This chapter is based on Rupert, J., Jehn, K.A., & Homan, A.C. (2009) and is therefore written in the first-person plural.

As organizations increasingly rely on teams as important building blocks of organizational effectiveness, there is a growing interest in understanding whether and how teams learn (cf. Wilson, Goodman, & Cronin, 2003). Research indicates that when teams are diverse in knowledge and information, this can lead to the integration of different views and perspectives which can stimulate teams to learn and find innovative solutions (Jackson, 1992; Bunderson & Sutcliffe, 2002; Van der Vegt & Bunderson, 2005). However, some teams are better able to manage and benefit from their diversity than others. Research indicates that the alignment of demographic attributes, creating so called diversity faultlines, can potentially disrupt group processes and performance, compared to cross-categorized groups in which memberships overlap (Brewer & Brown, 1998; Homan, Van Knippenberg, Van Kleef, & De Dreu, 2007a; Homan et al., 2008; Lau & Murnighan, 1998; Sawyer, Houlette, & Yeagley, 2006). As a result, faultline groups are more likely to experience the detrimental effects of diversity, whereas cross-categorized groups are more likely to experience the benefits of diversity. Yet, only few studies have been done on the relationship between demographic alignments within teams and team learning and the results are inconclusive (Gibson & Vermeulen, 2003; Lau & Murnighan, 2005).

To reconcile these mixed findings, it is important to know which factors facilitate team learning in teams with different group compositions. In this study, we examine the role of error culture as a crucial climate factor which is highly relevant for team learning. Research has shown that a climate which stimulates the open discussion of errors can lead to new insights and future adjustments, thereby boosting team learning and innovation (Edmondson, 1996; 1999; Van Dyck, Frese, Baer, & Sonnentag, 2005; Rochlin, 1999). In this experimental study, we investigate how error culture affects team learning in groups with a faultline versus cross-categorized composition. Since faultline groups have the potential to suffer from disruptive routines (Lau & Murnighan, 1998), they have relatively more to gain and to loose from an effective versus ineffective error culture. We therefore expect that error culture will have a greater effect on team learning in faultline groups than in cross-categorized groups. Additionally, we examine the role of psychological safety and open communication as underlying factors explaining these relationships.

Diversity Composition and Team Learning

Faultlines can be defined as hypothetical dividing lines that can split a group in relatively homogeneous subgroups based on the alignment of demographic attributes (definition adapted from Lau & Murnighan, 1998). Faultlines have been assumed to potentially disrupt group processes and performance (Lau & Murnighan, 1998; Thatcher, Jehn, & Zanutto, 2003). The alignment of multiple demographic attributes in a group creates convergent categories, which can make subgroup categorizations more salient (Brewer, 2000; Van Knippenberg, De Dreu & Homan, 2004; Hogg, 1996). Through increased comparative fit, group members perceive differences within subgroups to be less than differences between subgroups (Oakes, Haslam & Turner, 1994; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987). These subgroup categorizations may result in stereotypes and in-group/out-group biases (Hogg, Turner, & Davidson, 1990; Lau & Murnighan, 1998), leading to increased interpersonal tensions and intragroup conflict and reduced information sharing, satisfaction, social integration, and performance (Bezrukova, Jehn, Zanutto, & Thatcher, 2009; Early & Mosakowski, 2000; Lau & Murnighan, 2005; Li & Hambrick, 2005; Molleman, 2005; Homan et al., 2007a; 2007b; 2008; Philips, Mannix, Neale, & Gruenfeld, 2004; Rico, Molleman, Sánchez-Manzanares, & Van der Vegt, 2007; Sawyer et al., 2006; Thatcher et al.,2003). So far, few studies have addressed the relationships between faultlines and team learning and the few that did found mixed results. In a field study, Gibson and Vermeulen (2003) found that strong faultline groups had low levels of team learning while moderate faultline groups, in which diversity characteristics are more likely to cross cut each other, showed higher levels of team learning. However, in their experimental field study, Lau and Murnighan (2005) found that faultlines were not related to team learning, in contrast to their hypothesis that faultlines would be negatively associated with team learning. The link between faultlines and team learning thus seems to be inconclusive. Our next question is what we know about teams with a cross-categorized composition.

When subgroup members share salient demographic attributes with members from the other subgroup faultline strength is reduced. This *cross-subgroup alignment* of attributes is likely to reduce comparative fit and decreases boundaries between subgroups (Brewer & Brown, 1998; Hewstone, Rubin, & Willis, 2002; Homan et al., 2007a). Migdal's et al. (1998) meta-analysis

indeed showed that the convergence of social categories accentuates the differences between and the similarities within subgroups, while crossed categories emphasize the similarities between different categories and differences within each category. As a result, members identify with multiple social identities in the group which is found to reduce intergroup bias, stereotyping, and intergroup conflict (e.g., Brown & Turner, 1979; Marcus-Newhall, Miller, Holtz, & Brewer, 1993). Although past research on crossed categorization has not yet studied team learning, some recent studies indicate that cross-categorized groups have higher levels of information elaboration and satisfaction, and better decision making and performance, compared to faultline groups (e.g., Homan et al., 2007a; Homan et al., 2008; Sawyer et al., 2006). Therefore, cross-categorized groups are likely to experience relatively higher and more stable levels of team learning than faultline groups. In this study, we extend this earlier work by focusing on team learning in faultline and cross-categorized groups. More specifically, we predict that the effects of different diversity compositions depend on a crucial moderator, which is the role of error culture. In the next section we will elaborate on this concept.

Error Culture

Errors can be defined as unintended deviations from plans, goals, or adequate feedback processing, as well as incorrect actions resulting from lack of knowledge (Van Dyck et al., 2003; Reason, 1990). Errors can have negative consequences (e.g., loss of time, wrong decisions), and therefore, many organizations tend to punish the occurrence of errors (Van Dyck et al., 2005). In order to make future changes and to learn and innovate as an organization, however, it can be extremely relevant to share and learn from error knowledge (Edmondson, 1996; 1999; Van Dyck et al., 2005; Rochlin, 1999). The norms and beliefs that the team holds regarding errors and error handling, represented by the team's error culture, greatly determines whether error knowledge is shared and therefore whether team learning occurs (Van Dyck et al., 2005; Frese, 1991; 1995). A constructive error culture could potentially help teams to overcome dysfunctional processes. On the other hand, team learning is more likely to suffer when the error culture is negative. Therefore, in this study we examine

two types of error cultures: error management versus error aversion (Van Dyck et al., 2005).

An error management culture decreases negative and increases positive error consequences by communication about errors, sharing error knowledge, and by quickly detecting and handling errors. This culture is shown to positively influence team learning and group and firm performance (e.g., Edmondson, 1996; Homsma, Van Dyck, De Gilder, Koopman & Elfring, 2009; Van Dyck et al., 2005). In contrast, an error aversion culture is characterized by individuals covering up errors and experiencing strain from errors, and is proposed to negatively affect team learning and performance (Van Dyck et al., 2005). People are often inherently hesitant to talk about their errors out of fear that they will be blamed and their errors will be attributed to undesirable personality traits, lack of knowledge and abilities, or low intelligence (Cannon & Edmondson, 2005; Brown, Williams, & Leeshaley, 1994; Edmondson, 1999). This fear of rejection leads people in an error aversion culture to cover up their errors, which in turn results in repeated mistakes and little learning (Stewart, 1997). In the next section, we will argue that these error cultures will have different effects on team learning in faultline versus cross-categorized teams.

The Present Study

As argued before, faultline groups, compared to cross-categorized groups, have relatively more to gain from a team culture that stimulates team learning and, at the same time, more to loose when the team culture is inhibiting learning. An error management culture promotes the sharing and reflection upon error knowledge in the team as a whole, thereby stimulating team learning (e.g., Edmondson, 1996; Homsma et al., 2009). We expect that in this culture, faultline teams are more likely to act as supportive cohorts (Gibson & Vermeulen, 2003), with subgroup members being encouraged to share and reflect upon knowledge and views on issues in the team as a whole. Past research shows that when individuals form cohorts with others with similar backgrounds that will support their view, opinions are more likely to be expressed and others are encouraged to listen (Asch, 1952, 1965; Azzi, 1993; Wittenbaum & Stasser, 1996). We expect that this will stimulate team learning in faultline teams with an error management culture. In contrast, in an error

aversion culture, errors must be prevented as much as possible and team members experience strain from errors that occur. This culture leads team members to cover up errors which may further divide subgroups and deteriorate team learning in the team as a whole.

Cross-categorized groups, in contrast, have less potential to split up into subgroups than faultline teams since social categories overlap and team members have more commonalities with each other. As a result, cross-categorized groups are more likely to exchange and elaborate upon relevant information, knowledge, and views in the team as a whole (Homan et al., 2007a; 2008; Sawyer et al., 2006), which is likely to stimulate team learning. Since cross-categorized groups will have more effective group processes in general, the potential detrimental and beneficial effects of an error culture will be less influential. In an error aversion culture, the cross-categorized team is less likely to divide into subgroups and experience intergroup bias than the faultline team, whereas an error aversion culture will have relatively less potential to improve team learning, as the group is likely to show relatively high and stable levels of team learning. Therefore, we expect that the potential positive effect of an error management culture and the potential negative impact of an error aversion culture is greater for faultline groups than for cross-categorized groups. These considerations bring us to our first hypothesis:

> **Hypothesis 1.** *Error culture moderates the effect of group composition on team learning and team performance, that is, the potential beneficial effect of an error management culture and the potential negative effect of an error aversion culture on team learning is greater in faultline groups than in cross-categorized groups.*

To summarize, we discussed the moderating role of error culture and argued that an error management culture is likely to weaken negative faultline effects, while an error aversion culture can worsen negative faultline effects. The effect of error culture will be less influential in groups with a cross-categorized composition. We now discuss two possible mediating mechanisms that can help explain the moderating role of error culture in faultline groups. These mechanisms are psychological safety and open communication.

The Mediating Role of Psychological Safety

The first underlying mechanism that we examine in this study is the role of psychological safety, which is the shared belief that a team is safe for interpersonal risk-taking (Edmondson, 1999; 2002). In a psychologically safe team, members feel confident that their team members will not embarrass and reject each other for being different, for bringing up tough issues and mistakes, and for presenting new ideas or asking questions. In contrast to cross-categorized teams, faultline teams have the potential for being unsafe at the team level with team members being psychologically located within their subgroups of others with a similar background (Nesdale and Mak, 2003; Rupert & Jehn, 2008). Team members are less likely to bring up tough issues and ask each other questions and feedback at the general team level. On the other hand, faultlines may act as supportive cohorts in certain circumstances, with subgroup members supporting each other based on common attitudes towards issues (Murnighan and Brass, 1991). These supportive cohorts can make it psychologically safer for subgroup members to ask questions, present new ideas, or give feedback, because they feel supported by others with similar views (Asch, 1952; Crott & Werner, 1994; Gibson & Vermeulen, 2003). We propose that error culture is a crucial climate factor that will trigger these different mechanisms in faultline teams.

An error management culture actively works against fears of embarrassment and rejection by others, by rewarding the communication about errors and by inhibiting their punishment (Edmondson, 1999). This culture is therefore likely to stimulate psychological safety in faultline teams, and to set supportive cohorts in motion that will stimulate team learning. On the other hand, an error aversion culture is focused on team members covering up their errors out of fear of embarrassment and rejection. This culture is therefore likely to harm the team's psychological safety and to strengthen in-group out-group biases that may exist in faultline teams (Lau & Murnighan, 1998; Van Knippenberg et al., 2004). We therefore propose that:

> **Hypothesis 2a.** *Error culture moderates the effect of group composition on psychological safety. Faultline groups are more psychologically safe when the group culture is focused on error management rather than error aversion, whereas psychological safety in cross-categorized groups is less affected by error culture.*

Past research has shown that psychological safety promotes team learning (e.g., Carmeli, 2007; Edmondson, 1999; Nembhard & Edmondson, 2006; Tjosvold, Yu, & Hui, 2004). When team members experience their group as a safe place for expressing new ideas and opinions without the fear of being rejected, team members are more likely to speak up, share task-relevant knowledge and information, and consider each other's viewpoints, which foster team learning (Edmondson, 1999; 2002). We propose that psychological safety will help explain why different error cultures will have different effects on team learning in faultline groups. We hypothesize that an error management culture will promote team learning in faultline groups, due to higher levels of psychological safety, while an error aversion culture will inhibit team learning in faultline groups, due to decreased levels of psychological safety. Thus,

> **Hypothesis 2b.** *The effect of error culture on team learning in faultline groups is mediated by psychological safety.*

The Mediating Role of Open Communication

The second mechanism that we examine in this study is open communication, which is the extent to which all team members communicate openly and freely with each other (Gibson & Vermeulen, 2003; Hyatt & Ruddy, 1997). In faultline teams, subgroups are often divided with more communication within than between subgroups (Lau & Murnighan, 1998; Nesdale and Mak, 2003). Therefore, the open communication in faultline teams can suffer. Some studies indeed show that faultlines affect specific communication patterns in teams (Lau & Murnighan, 2005; Sawyer et al., 2006). However, the effects of faultlines on the open communication in the team as a whole have not yet been investigated. We expect that an error culture discouraging the communication about errors and stimulating team members to cover up errors is likely to strengthen these subgroup divisions and to stimulate team members to communicate primarily within their subgroup rather than in the team as a whole. As a result, the open communication in the team will suffer. On the other hand, an error management culture explicitly promotes the communication about errors, which will stimulate team members to voice their views and to openly discuss mistakes as a group (Edmondson, 1996; 1999). In this culture, subgroups are more likely to act as healthy divides,

with team members voicing their opinions and views and share their knowledge and information in the group as a whole. Therefore, we propose:

> **Hypothesis 3a.** *Error culture moderates the effect of group composition on open communication. Faultline groups communicate more openly when the group culture is focused on error management rather than error aversion, whereas open communication in cross-categorized groups is less affected by error culture.*

Research has shown that open communication stimulates team performance (Barry & Stewart, 1997; Hyatt & Ruddy 1997). When team members communicate openly with all members in the group, the exchange and reflection upon viewpoints and ideas is stimulated, which is likely to promote team learning (Argote, Gruenfeld, & Naquin, 2001; Bunderson & Sutcliffe, 2002). We therefore argue that open communication will mediate the relationship between error culture and team learning in faultline groups. We hypothesize that an error management culture will lead members to communicate more openly which will stimulate team learning, while error aversion culture will inhibit open communication in the team which will lead to lower levels of team learning. Thus, we propose that:

> **Hypothesis 3b.** *The effect of error culture on team learning in faultline groups is mediated by open communication.*

Method

Sample and Design

A total of 284 students (142 men and 142 women) from a Dutch University participated in the experiment for course credit or monetary compensation (9 euros, approximately $12 U.S.). The mean age of participants was 21 years (*SD* = 2.85) and 97.2 percent were Dutch[1]. Participants were assigned to one of the conditions of a 2 (group composition: faultline versus

[1] Controlling for heterogeneity in age and nationality did not change the pattern of results. We therefore proceeded to test our hypotheses without controlling for these variables.

cross-categorized group) x 2 (error culture: error management culture versus error aversion culture) factorial design. A total of 71 four-person groups participated in the experiment.

The Task

We used an existing cognitive task that required group information processing and decision making skills (Jehn & Shah, 1993). We informed groups that they represented a selection committee that had to decide which candidates to invite for a job interview. We gave participants four application letters and a vacancy text for the position of a research program coordinator. We told them that they had 20 minutes to rate the applicants based on four criteria (secretarial potential, research skills, language abilities, and social skills), and to make final invite, wait-list, or reject decisions. We did not inform groups how many of the four should be invited, wait-listed, or rejected. The group had to indicate their final decision on a group decision agreement form that each individual group member had to sign. In order to assess objective team learning the group performed the selection task twice. Each task consisted of different application letters for the same job opening. Task order was counterbalanced and a pretest indicated that the tasks were equally difficult.[2] The three best groups each received a group prize of 80 euros as a team for their performance on task 2 (approximately $112 U.S.). Groups were videotaped during both tasks. After task 2 participants were debriefed and thanked.

Procedure

Manipulation of group composition. To create faultline and cross-categorized groups, we converged and cross-cut existing demographic

[2] To test whether the tasks were equally difficult, we conducted a pilot test on 19 individuals performing both tasks. We assessed how many correct answers individuals had on each task (range 0-4) and we asked individuals how difficult they found each task on a 1-5 point scale. A paired sample t-test indicated that both tasks were equally difficult, with a similar amount of correct answers for each task (t (18) = 1.29, p = .22;), and team member reporting similar levels of difficulty for each task (t (18) = .77, p = .45). The means for the amount of correct answers were 1.74 (SD = 1.15) on task 1 and 1.32 (SD = .89) on task 2. The means for perceived difficulty of the task were 2.89 (SD = 1.10) on task 1 and 2.74 (SD = .93) on task 2.

characteristics of participants. We used gender and educational major to compose groups, since gender is a salient basis for categorization (Stangor, Lynch, Duan, & Glass, 1992) and educational background represent differences in knowledge, views, and information (Jackson, May, & Whitney, 1995; Harrison et al., 1998), which is relevant for team learning. We recruited men and women with study majors in social sciences versus basic sciences.[3] In the faultline condition, same gender and study major pairs were always seated next to each other at a rectangular table, facing the participants with a different gender and study major (Homan et al., 2007a; 2007b). In the cross-categorization condition gender and study major were crossed, with groups consisting of male and female social science students and male and female basic science students. On arrival at the lab, group members were asked to attach a name tag to their clothes in a visible way. The badge indicated participants' full name and specified their study major ('social sciences' or 'basic sciences'). To further enhance the manipulation of group composition, the experimenter asked participants to read their badge out loud while looking into one of the cameras, for administrative reasons (the experimenter explained that the researchers would not be able to read the badges from the video recordings). After these procedures to make group composition salient, participants received task instructions. In the upper left corner of the sheet, their group composition was specified in a box, further enhancing the manipulation of group composition. Using these procedures, we created a clear compositional faultline by converging multiple diversity characteristics (i.e. gender, study major) in the faultline condition and crossing these characteristics in the cross-categorized condition.

To check our manipulation of group composition we asked group members to fill out how their group was composed ("My team consists of (include yourself): __ males __ females," and, "All males are basic/social sciences yes/no"). We also asked team members how many team members of each social category were present in the group ("My team has (include yourself): __ males basic sciences, __ females basic sciences" etc).

Manipulation of error culture. Before participants started working on the task they received some additional information about working in teams, which included our manipulation of error culture. Based on the work by Van Dyck et al. (2005), groups in the error management condition read that errors

[3] Social sciences included psychology, pedagogy, anthropology, and political science; basic sciences included physics, biology, medical sciences, and (technical) mathematics.

can be good for team performance and that the more a team discusses, analyzes, and corrects errors, the better the team performs ("Team research shows that making errors is good for team performance. The more you discuss errors, analyze and correct them, the better you perform as a team. (…). So when you work together as a team, make sure that you analyze and share your errors, resolve them and correct errors that have been made").

In contrast, team in the error aversion condition read that research had shown that errors can be bad for team performance and that team members often feel embarrassed and can be irritated after making a mistake and that, therefore, it is better to prevent errors as much as possible and to cover them up in case they occur ("Team research shows that making errors is bad for team performance. The more you prevent errors, the better you perform as a team. (…) So when you work together as a team, make sure that you prevent errors as much as possible and do not discuss errors with each other"). Following this information, participants received information about the task.

We checked the manipulation of error culture using an adaptation of existing scales by Van Dyck et al. (2005). To check our manipulation of error management culture, we used five items (e.g., "It is important to discuss errors to reveal the cause") and the manipulation of error aversion culture was also checked with five items (e.g., "It is not good to discuss errors with other team members"). PCA on both tasks revealed that there were two underlying factors indicating that error management and error aversion culture were distinct. The items formed reliable scales (error management $\alpha = .87$; $M = 5.39$ $SD = 3.71$; error aversion $\alpha = .80$, $M = 3.71$; $SD = 1.30$). All responses were given on 1-7 Likert scales (1 = totally disagree; 7 = totally agree).

We aggregated individuals´ answers on the manipulation checks to the group level, as the answers of group members are not likely to be independent (Kashy & Kenny, 2000). We computed ICC[1] and ICC[2] scores and r_{wg} scores to check whether aggregation was appropriate (e.g., Bliese, 2000; Klein & Kozlowski, 2000). For error management we got an ICC [1] value of .06, and ICC[2] was .20, with a r_{wg} value of .65. Although these aggregation values are relatively low, these values are seen as acceptable for team research (Le Breton & Senter, 2008). The aggregation measures for error aversion culture justified aggregation to the group level (ICC [1] = .42, ICC[2] = .74, r_{wg} .75).

Measures

We performed triangulation of multiple measurements, which provided a rigorous examination of group processes (Denzin, 1978). To measure the process variables and the dependent variables, we used behavioral ratings of videotapes and objective measures of team learning (i.e. number of correct decisions made on task 2 versus task 1). The behavioral ratings of the videotapes and the objective learning measure provided direct and unobtrusive measures of psychological safety, open communication, and team learning (see Jehn & Shah, 1997). The manipulation check questionnaire provided self-report responses from the participants.

Videoratings

Two independent coders blind to the hypotheses coded all 71 videos. Raters were given definitions of psychological safety, open communication, and team learning, which are described below. They rated the behaviors on a scale of 1 *(strongly disagree)* to 7 *(strongly agree)*. When video ratings on a variable were further than 1 point apart, the coders discussed their rating of the behavior until they reached agreement (Jehn & Shah, 1997). We had overlapping ratings of 44% of the groups to determine inter-rater agreement. We assessed inter-rater reliability by computing the intraclass correlations (Shrout & Fleiss, 1979). The ICC's for the two raters ranged from .73 to .90 (psychological safety ICC[1] = 75; open communication ICC[1] = .90; team learning ICC[1] = .74), which is considered excellent according to the criteria determined by Cicchetti and Sparrow (1981).

Process Variables

Psychological safety. A team can be regarded as psychologically safe when team members display vulnerable behavior, such as asking each other questions or feedback, giving their view, bring up tough issues, and team members react to these behaviors in a constructive way, without criticizing or rejecting each other (Edmondson, 1999). Raters coded the extent to which such behaviors and reactions were displayed on a 1-7 point scale. A 1 or 2 was given when team members did not respect each other, did not consider each other's viewpoints, or made a fool of candidates that were discussed (e.g., "This letter is thick, you take this one!"; "This candidate is good, he graduated cum laude!" – (reponds with) "Oh no, don't take someone like that, they lack social skills!"). A 3 was given when there is an atmosphere of politeness, but team members did

not go into a real discussion. Team members mostly work in peace and exchange some information now and then. A 4 or 5 was given when the atmosphere was friendly, and team members asked each other questions and/or admitted that they did not have knowledge about specific areas (e.g., "Why do you think we should invite him?", or "This candidate says he studied communication science, does that exist?", and "To be honest, I don't know what these subjects are about"). A 6 was given when team members displayed vulnerable behaviors by admitting that they missed important information (e.g., "This lady is much older than other candidates, she is almost 50", other responds: "Oh really? I did not notice that!", and "I am sorry, I did not listen to what you said"). A 7 was given when team members exchanged personal vulnerabilities (e.g., "I am slow and dyslexic").

Open communication. Open communication is the extent to which all team members have a chance to express their view and communicate openly with each other (Gibson & Vermeulen, 2003; Hyatt & Ruddy, 1997). Raters gave a 1 or 2 when there almost no communication at all, or when one person was excluded from discussion or excluded him or herself from the discussion. A 3 was given when the communication mostly took place between two team members and these two did not really attend to what others said. A 4 or 5 was given when all team members talked, but one person talked notably less than others. Raters gave a 6 when all team members took part in the discussion; everybody attended and reacted to what was being said, but some members talked more than others. A 7 was given when all team members took part in the discussion and team members talked about just as much.

Dependent Variables

Team learning behavior. Coders rated the extent to which the teams learned about the content of the task (Jehn & Rupert, 2007), for instance by reflecting upon and making sense of information about the candidates, vacancy, selection criteria, and/or the assignment. The higher this item was rated, the higher the level of task learning. A score of 1 or 2 was given when group members hardly shared their views and reflected upon the assignment, the vacancy, selection criteria, or candidates. A 3 or 4 was given when the team discussed the candidates, but in a relatively unstructured way, so important information regarding the assignment or criteria was not shared and reflected upon. A 5 was given, for instance, when team members discussed the assignment thoroughly, but only briefly reflected upon all candidates, or some candidates were discussed extensively, with little time left for others. A score of

6 was given when participants shared and reflected upon a lot of knowledge and exchanged their views upon certain issues (e.g., "The most important thing is that the education is ok and language skills are good, SPSS is something you can learn"). A 7 was given when – on top of this – they reflected upon information in a very structured way (e.g., "I think that to check their language skills, we should also look if their English letter is well written"; "I would invite them both, if they fit the requirements, because then you can compare and choose the best one").

Objective team learning. Following group learning-curve research (e.g., Adler, 1990; Darr, Argote, & Epple, 1995; Edmondson, Winslow, Bohmer, & Pisano, 2003) that has operationalized team learning in terms of objective improvement rates (e.g., yield improvement, productivity improvement, cost decrease), objective team learning was calculated as the change in performance from task 1 to task 2. Performance was determined by the degree to which group decisions matched the official admissions committee decisions (Jehn & Shah, 1997). Comparison with experts' performance is a common way to assess group performance (McGrath, 1984). Team performance scores were therefore based on the number of times group decisions matched those of the admissions committee. For instance, when the group decided to correctly invite a candidate they earned one point. For each task, a group could earn a maximum of 4 points. To calculate the final objective team learning measure, a difference score was calculated between task 1 and 2 (range -2 to 3), with positive scores indicating team learning.

Results

Manipulation checks

Our manipulation check of group composition was successful. All participants correctly indicated how their group was composed. The manipulation of error culture also had the desired effect. Groups in the error management condition ($M = 5.63$, $SD = .45$) indicated that their group culture was more focused on error management than groups in the error aversion conditions ($M = 5.19$, $SD = .76$), $F(1, 40) = 5.89$, $p = .03$, $\eta^2 = .10$. Groups in the error aversion condition ($M = 4.38$, $SD = .87$) indicated that their group culture was more focused on error aversion than groups in the error management

condition (M = 2.99, SD = 42), F (1, 40) = 5.58, $p < .001$, $\eta^2 = .48$. The manipulation checks were not affected by the group composition manipulation (error management $F(1,40) = .16$, $p = .69$, $\eta^2 = .00$, error aversion $F(1,40) = .42$, $p = .52$, $\eta^2 = .01$) and the interaction between group composition and error culture (error management $F(1,40) = .73$, $p = .40$, $\eta^2 = .02$, error aversion $F(1,40) = .62$, $p = .44$, $\eta^2 = .02$).

Hypotheses Tests

In Table 1, the correlations between the dependent variables are displayed. We used analysis of variance to test hypothesis 1, 2a, and 3a (see Table 2) and regression analysis to test hypothesis 3.

Table 1. *Correlations among the Dependent Variables*

	M	*SD*	*1*	*2*	*3*	*4*
1. Psychological Safety	4.40	1.29	-			
2. Open Communication	4.52	1.57	.39***	-		
3. Team Learning Behavior	4.79	1.15	.44***	.56***	-	
4. Team Learning Objective	-.17	1.30	.11	.03	.23†	-

Note. *** $p < .001$,** $p < .01$, * $p < .05$, $^{\dagger} p < .10$

In hypothesis 1, we proposed that the potential beneficial effect of an error management culture and the potential negative effect of an error aversion culture on team learning is greater in faultline groups than in cross-categorized groups. We found no main effect of group composition on the videoratings of team learning behavior: faultline groups (M = 4.78, SD = 4.79) showed similar levels of team learning as cross-categorized groups (M = 4.79, SD = 1.18), F (1, 67) = .03, $p = .87$, $\eta^2 = .00$. We did find a significant main effect of error culture, indicating that groups with an error management culture (M = 5.04, SD = 1.02) displayed higher levels of team learning behaviour than teams with an error aversion culture (M = 4.50, SD = 1.22), F (1, 67) = 4.04, $p = .05$, $\eta^2 = .06$. More importantly, and in line with hypothesis 1, this main effect was driven by an interaction with group composition. Supporting hypothesis 1, we found a

Table 2. *Effects of Group Composition and Error Culture on Psychological Safety, Open Communication, and Team Learning*

	Faultline Groups				Cross-Categorized Groups			
	Error Management		Error Aversion		Error Management		Error Aversion	
Measures	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Psychological Safety	4.85[ac]	1.10	3.87[b]	1.19	4.49[abc]	1.53	4.33[ac]	1.21
Open Communication	5.00[a]	1.26	3.67[b]	1.81	4.44[ab]	1.69	4.81[ab]	1.34
Team Learning Behavior	5.24[a]	.87	4.27[b]	1.21	4.85[ab]	1.14	4.74[ab]	1.23
Team Learning Objective	-0.59[a]	1.18	-0.07[a]	1.39	-0.06[a]	1.51	0.00[a]	1.14

Note. Means within a row with a different subscript differ at $p < .05$. Psychological safety, open communication, and team learning are videoratings with ranges from 0 to 7. Objective team learning represents the change in performance from task 1 to task 2, based on the amount of correct answers (range -2 to 3).

significant effect of error culture within faultline groups, indicating that faultline groups with an error management culture displayed higher levels of team learning behaviour than faultline groups with an error aversion culture F (1,67) = 5.89, p = .02, η^2 = .10 (see Table 2). In line with what was hypothesized, cross-categorized groups were not influenced by error culture (F (1, 67) = .08, p = .75, η^2 = .00; see Table 2). This effect is displayed in Figure 1.

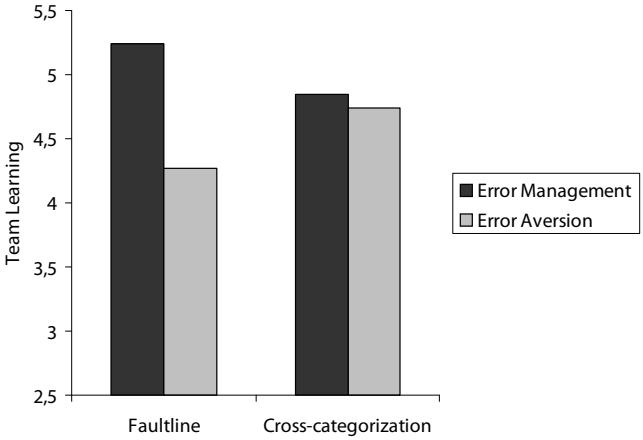


Figure 1. Team Learning Behavior as a Function of Group Composition and Error Culture

The objective team learning measure was not affected by the manipulations of group composition (F (1, 67) = .92, p = .34, η^2 = .01) and error culture (F (1, 67) = .86, p = .36, η^2 = .01), nor by the proposed interaction (F (1, 67) = 1.27, p = .26, η^2 = .01).

In hypothesis 2a, we proposed that the potential beneficial effect of an error management culture and the potential negative effect of an error aversion culture on psychological safety is greater in faultline groups than in cross-categorized groups. There was no main effect of group composition; faultline groups (M = 4.39, SD = 1.23) showed similar levels of psychological safety as cross-categorized groups (M = 4.41, SD = 1.35), F (1, 67) = .03, p = .86, η^2 = .00. We found a significant main effect of error culture, indicating that groups with an error management culture (M = 4.67, SD = 1.33) had higher levels of psychological safety than teams with an error aversion culture (M = 4,14, SD =

1.20), F (1,67) = 3,55, p = .05, η^2 = .05. More importantly, and in line with hypothesis 2, this main effect was driven by an interaction with group composition. A significant effect of error culture within faultline groups was found, indicating that faultline groups with an error management culture displayed higher levels of psychological safety than faultline groups with an error aversion culture, F (1,67) = 4.87, p = .03, η^2 = .07, see Table 2. In line with hypothesis 2a, cross-categorized groups had similar levels of psychological safety for the error management and error aversion condition, F (1, 67) = .24, p = .70, η^2 = .00, see Table 2. This effect is displayed in Figure 2.

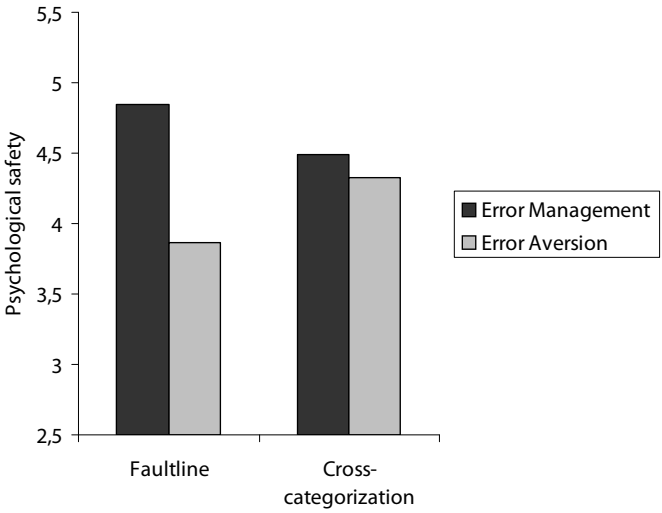


Figure 2. Psychological Safety as a Function of Group Composition and Error Culture

In hypothesis 2b, we proposed that the effect of error culture on team learning in faultline groups is mediated by psychological safety. To test this hypothesis, we conducted mediation analyses on a subset of our sample, that is, on the faultline condition only. To test mediation, three conditions must be met (Baron & Kenny, 1986). First, there must be a significant relationship between the independent and the dependent variable. Second, there must be a significant relationship between the independent variable and the mediator. Finally, when including the independent variable and the mediator in a regression analysis, the mediator should remain significant and the relationship between the interaction term and the dependent variable should disappear or

be suppressed.

We already established that error culture had a significant effect on team learning behavior in faultline teams (Step 1; see test Hypothesis 1). The second step, that faultline groups with an error management culture displayed higher levels of psychological safety than faultline groups with an error aversion culture was also supported (see results for Hypothesis 2a). To test the third step of the mediation analysis, we regressed team learning behavior on error culture and psychological safety. In line with hypothesis 2b, we found that the effect of psychological safety on team learning behaviour remained significant ($\beta = .47$, $p = .007$), and the main effect of error culture disappeared ($\beta = -.24$, $p = .14$), indicating full mediation. The Sobel test showed that the test of the indirect effect was significant ($z = -1.86$, $p = .05$; Sobel, 1982).

In Hypothesis 3a we proposed that faultline groups with an error management culture would communicate more openly than faultline groups with an error aversion culture, whereas open communication in cross-categorized would not be affected by error culture. We did not find main effects of group composition (F (1, 67) = .65, $p = .42$, $\eta^2 = .01$) and error culture (F (1, 67) = 1.77, $p = .19$, $\eta^2 = .07$). Faultline groups ($M = 4.38$, $SD = 1.66$) displayed similar levels of open communication as cross-categorized groups ($M = 4.64$, $SD = 1.50$). Similarly, groups with an error management culture ($M = 4.71$, $SD = 1.50$) did not significantly differ from groups with an error aversion culture ($M = 4.33$, $SD = 1.63$). Supporting hypothesis 3a, we did find a significant interaction effect of error culture within faultline groups, indicating that faultline groups with an error management culture had higher levels of open communication than faultline groups with an error aversion culture, F (1,67) = 6.10, $p = .02$, $\eta^2 = .08$, see Table 2. Error culture did not significantly affect open communication in the cross-categorized condition F (1, 67) = .56, $p = .46$, $\eta^2 = .01$, see Table 2. This effect is displayed in Figure 3.

In our final hypothesis we proposed that open communication would mediate the relationship between error culture and team learning in faultline groups. Again, we already established that error culture had a significant effect on team learning behavior in faultline teams (Step 1; see test Hypothesis 1). The second step, that faultline groups with an error management culture would communicate more openly than faultline groups with an error aversion culture, was also supported (see results for Hypothesis 3a). The regression analysis testing the third mediation step showed that the effect of open communication on team learning behavior remained significant ($\beta = .64$, $p < .001$), while the

main effect of error culture became non-significant (β = -.17, p = .23). A significant Sobel test (z = -2.15, p = .03) indicated full mediation, giving support

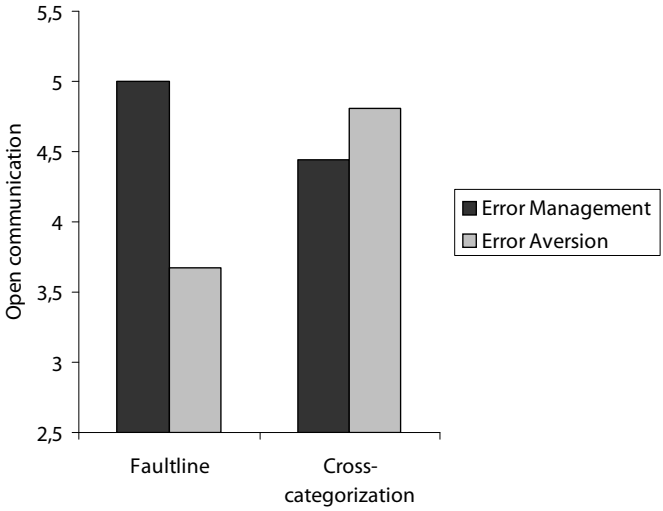


Figure 3. Open Communication as a Function of Group Composition and Error Culture

for hypothesis 3. We did not proceed with testing further mediation steps for objective team learning as the first mediation step was not significant (see hypothesis test 1).

Discussion

Although diversity in teams can potentially stimulate team learning and innovation (Bunderson & Sutcliffe, 2002; Van der Vegt & Bunderson, 2005), for some teams it is more difficult to benefit from their diversity than for others. To address this issue, we examined team learning in groups with different group compositions. We compared faultline groups, which are generally assumed to suffer from disruptive group processes (Lau & Murnighan, 1998; Van Knippenberg & Schippers, 2007), to cross-categorized groups, which are found to have a better and communication and information flow (Homan et al., 2007a;

2008; Sawyer et al., 2006). We investigated the moderating role of a factor that is important for team learning, which is the impact of error culture (Van Dyck et al., 2005; Frese, 1991; 1995). A team's error culture is comprised of the norms and beliefs that exist regarding errors and how errors should be handled (Van Dyck et al., 2005). We hypothesized and found that faultline groups can benefit from a culture that encourages the sharing of error knowledge, with higher levels of team learning as a result. An error management culture can thus weaken potentially disruptive effects that may originate in faultline teams. On the other hand, a culture focused on error aversion worsened negative faultline effects, resulting in lower levels of team learning. In line with what was hypothesized, error culture did not significantly affect team learning in cross-categorized groups.

Although the importance of error culture for team learning has been acknowledged (Edmondson, 1996; 1999; Van Dyck et al., 2005; Rochlin, 1999), a quantitative test manipulating error culture in diverse teams was lacking. This study thereby contributes to research on team culture, error handling, and team learning, by experimentally manipulating this climate factor in a laboratory setting. Additionally, the present findings contribute to the mixed findings of past research on work group diversity, which has been criticized because of its primary focus on main effects (Pelled, Eisenhardt, & Xin, 1999; Van Knippenberg & Schippers, 2007; Williams & O'Reilly, 1998). This study provides an empirical test of a moderator relevant for team learning, which is the role of error culture. More specifically, the present results indicate that the dominant view that faultlines are bad does not always hold. When a team culture allows a constructive way of dealing with errors, faultlines may act as healthy divides, stimulating team learning (Gibson & Vermeulen, 2003). Thus, error culture may help diverse teams to benefit from their diversity. On the other hand, when the error culture climate is focused on prevention this can exaggerate negative faultline effects and team learning will suffer. The present focus on error culture as a condition under which team learning in diverse teams may vary endorses the importance of adopting a contingency approach when studying the effects of work group diversity.

Additionally, and in line with past research (Carmeli, 2007; Edmondson, 1999; Tjosvold et al., 2004), psychological safety appeared to be an important antecedent of team learning behavior and mediated the relationship between error culture and team learning in faultline teams. Although past studies have examined the effects of faultlines on psychological safety (Lau & Murnighan, 2005; Rupert & Jehn, 2008), they have not yet examined the mediating role of

psychological safety in the relationship between error culture and team learning in faultline teams. In this study, psychological safety helped explain why faultline teams with an error management culture learned more than faultline teams with an error aversion culture. An error management culture stimulated team members in faultline groups to display vulnerable behaviors, such as asking questions, giving feedback, and bringing up tough issues, which stimulated team learning. An error aversion culture inhibited these behaviors.

Open communication was the second mediator in this study, which helped explain why an error management culture was positive and an error aversion culture was negative for team learning in faultline teams. Although past research has examined the effects of faultlines on specific communication patterns (Lau & Murnighan, 2005; Sawyer et al., 2006), open communication in the team as a whole has not yet been tested as an underlying process explaining faultline effects. The present results indicate that an error management culture can stimulate team learning in faultline teams by promoting open communication in the team. An error aversion culture inhibited team learning in faultline teams through decreased levels of open communication.

Limitations and Future Research Directions

We argued that error culture was more likely to affect team learning in faultline groups than in cross-categorized groups, as faultline group are more likely to suffer from disruptive routines (Lau & Murnighan, 1998). Therefore, faultline groups have relatively more to gain and to loose from an error culture than cross-categorized teams (see Homan et al., 2007a; 2008; Sawyer et al., 2006). As our results illustrate, cross-categorized teams had relatively high and stable levels of psychological safety, open communication, and team learning, compared to faultline teams, for which the effects fluctuated for different types of error culture. These findings suggest that cross-categorized groups indeed seem to be better able benefit from diversity as a baseline, while the effects in faultline groups depend more on the circumstances. However, to test this baseline assumption empirically, a neutral error culture condition should be added, in which beliefs regarding how to handle errors are not specified.

In this study, we contributed to past research on team learning by developing an experimental design consisting of two tasks, which allowed us to objectively assess learning by comparing performance on task one and two.

Performance was calculated based on the degree to which group decisions matched the official admissions committee decisions (Jehn & Shah, 1997), and objective learning reflected the difference score between performance on task 1 compared to performance on task 2. Surprisingly, the objective team learning measure was not affected by our manipulations. A reason for this could be that the team did not necessarily need to display team learning behaviors in order to improve team performance. As the correlation table indicates, there is only a marginal positive correlation between team learning behavior and objective team learning. Thus, it might have been the case that high learning teams might have discussed and reflected upon relevant knowledge and information, but ended up with wrong decisions, for instance due to too lengthy discussions, internal politics, or other distractions. As past research shows, team learning can be distracting from effective performance, especially in early phases of a group's development (Bunderson & Sutcliffe, 2003). Therefore, future research should investigate whether team learning behaviors actually result in actual improvement making and under which circumstances. Also, future research should measure to what extent team learning behaviors can be distracting from effective performance.

Finally, to increase the external validity of this study, the current findings should be replicated in the field. Future research may investigate to what extent workgroups in organizations differ in their error culture and how this affects the relationship between group composition and team learning. Alternatively, an error management culture could be manipulated in a field training to see to what extent this can help diverse teams to learn. Also, it would be interesting to examine the circumstances under which different error cultures might be most beneficial. Recent research has shown, for instance, that when error consequences are severe, people are more likely to communicate and learn from errors and thus adopt an error management attitude (Homsma et al., 2009). An error aversion culture, in turn, might have beneficial effects when the required accurateness is high, but error consequences are low.

Practical Implications

The present findings have important implications for the management of diverse groups in organizations. Managers can stimulate team learning in faultline groups by promoting the communication about errors. When team members believe that they can openly share error knowledge, this will stimulate

psychological safety and open communication, with higher levels of team learning as a result. This is especially relevant for faultline teams, which may potentially suffer from disruptive routines and an unsafe climate (Lau & Murnighan, 1998; Thatcher et al., 2003; Rupert & Jehn, 2008). However, organizations often tend to focus on the prevention of errors and managers often get angry at people when they make mistakes (Van Dyck et al., 2005). This can worsen negative error consequences, especially in faultline teams, since team members will hide their errors and errors do not get resolved, with the likelihood of repeated mistakes. Therefore, managers should create an open atmosphere in which errors can be discussed, without blaming people. By revealing the cause of errors, the error can be prevented from occurring in the future and damage can be controlled. For instance, managers could present well-managed error incident as best practices in a general organizational meeting and thereby use an error that occurred in a team as a learning opportunity for the department or organization as a whole (Van Dyck et al., 2005).

Conclusion

To summarize, this study showed that in faultline teams, an error management culture can stimulate team learning, while an error aversion culture can inhibit team learning. Cross-categorized teams had relatively high and stable levels of team learning, which were not affected by error culture. Psychological safety and open communication mediated the relationship between error culture and team learning in faultline teams. Faultline teams with an error management culture displayed higher levels of psychological safety and open communication than faultline teams with an error aversion culture. An error management approach can be adopted in order to help faultline teams to overcome potential disruptive effects and stimulate team learning.