Diving Deep into Team Adaptation: How Does it Really Unfold Over Time?

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Abstract

Objective: We investigated whether teams adapt to an unexpected event by executing the four-phase team adaptation process (i.e., situation assessment, plan formulation, plan execution, and team learning), and whether the execution of this four-phase sequence leads to high team performance as proposed by Rosen et al. (2011).

Method: In a laboratory study, we observed 70 teams of four individuals performing a task after an unexpected event. We coded the sequence of team adaptation phases based on team members' communications and behaviors. For hypothesis testing, we performed a lag sequential analysis in order to determine whether sequences of team adaptation phases occurred (a) more often than other sequences and (b) more often in high- vs. low-performing teams.

Results: Theoretically predicted phase sequences did not occur more often than other phase sequences, except for the two-phase sequence situation assessment followed by plan execution. Instead, teams performed "forward-backward" sequences between plan formulation and plan execution and between plan formulation and situation assessment. Theoretically proposed sequences were less frequent in high versus low performing teams, while other phase sequences not proposed by theory were more frequent in high-performing teams. This suggests that high-performing teams were more flexible in their sequencing of team adaptation phases.

Conclusions: Our research suggests more flexible sequences of team adaptation phases than proposed by theory and thus draws a nuanced picture of the complex nature of the team adaptation process. To fully capture the team adaptation process, we suggest incorporating "forward-backward" phase sequences into team adaptation theory.

Keywords: team adaptation process, team performance, sequence analysis

Diving Deep into Team Adaptation: How Does it Really Unfold Over Time?

Today's organizations often rely on teams rather than individuals to deal with changes, unforeseen events, complex tasks, and uncertainties (Kozlowski, Gully, Nason, & Smith, 1999). Teams can build on their members' diverse knowledge and expertise, a quality especially valuable when confronted with unexpected challenges and when there is a need to adapt to various demands. Thus, a team's capacity to be adaptive represents a crucial factor for organizational success (Kozlowski, Watola, Jensen, Kim, & Botero, 2009).

Over the past two decades, researchers have stressed the importance of team adaptation (for a review, see Maynard, Kennedy, & Sommer, 2015). So far, empirical work suggests a positive relationship between adaptive behaviors (e.g., coordination) and different team-level outcomes, such as post-change team performance (e.g., Chen, Thomas, & Wallace, 2005; Svedrup, Schei, & Tjolsen, 2017) while the dynamic team adaptation *process* "…is too often viewed as occurring within a 'black box' that goes unmeasured" (Maynard et al., 2015, p. 8). Specifically, research that addresses the team adaptation process which teams execute when facing unexpected events is mainly theoretical (e.g. Burke, Stagl, Salas, Pierce, & Kendall, 2006; Rosen, Bedwell, Wildman, Fritzsche, Salas, & Burke, 2011). Empirical research investigating the dynamic nature of the team adaptation process is missing (Baard, Rench, & Kozlowski, 2013). To our knowledge, only single components of the team adaptation process have been investigated, thus neglecting the dynamic team adaptation process as a whole (e.g., Ellwart, Happ, Gurtner, & Rack, 2015; van den Heuvel, Alison, & Power, 2014).

In an effort to support teams to adapt successfully to unexpected events, our first goal is to better understand the process through which teams undergo when responding to unexpected events. Second, we aim to explore why some teams adapt more effectively than others in order to ultimately enhance team performance. Building on the team adaptation process model presented by Rosen et al. (2011), we argue that teams adapt successfully to unexpected events by executing the complete team adaptation process constituting four consecutive phases: situation assessment, plan formulation, plan execution, team learning. Going beyond previous studies that have investigated only single components of the four-phase team adaptation process and hence only partially explain team performance under unexpected conditions, we explore how teams naturally respond to unexpected events and whether the suggested four-phase sequence leads to high team performance.

Theoretical Background

The team adaptation process describes different actions that a team performs in response to changes in the environment, in the task, or within the team itself (Baard et al., 2013). It is a dynamic course of action that unfolds over time and is conceptualized as a “response to a salient cue or cue stream that leads to a functional outcome for the entire team” (Burke et al., 2006, p. 1190). In contrast to other more generic frameworks (e.g., Maynard et al., 2015), Rosen et al. (2011) focuses solely on team adaptation and conceptualizes the team adaptation process as a sequence of the following four phases: situation assessment, plan formulation, plan execution, and team learning. Rosen et al. (2011) also specified which specific team processes constitute the different phases of the team adaptation process (e.g., cue recognition, meaning ascription, and team communication for situation assessment). Further, they argued that specific team emergent states, such as motivation, support the team's ability to effectively cope with unexpected events. Overall, Rosen et al. (2011) proposed that teams who run through the complete suggested four-phase sequence (in comparison to teams that do not) are more successful in adapting to unexpected events.

Although several empirical studies have used the four-phase team adaptation process model as their theoretical foundation (e.g. Randall, Resick & DeChurch, 2011; Sander, van Doorn, van der Pal, & Zijlstra, 2015), only two studies so far have investigated the phase sequences of the team adaptation process. Specifically, Ellwart et al. (2015) developed an online team adaptation intervention that was structured according to the first two phases of the team adaptation process. Researchers showed that the intervention supported the team’s ability to reduce information overload and to improve the team mental model quality when there was a need to adapt. Furthermore, van den Heuvel et al. (2014) assessed the coping strategies of police officer teams performing a negotiation simulation and showed that coping strategies reflecting the sequence of the first three team adaptation phases supported teams to effectively manage the demanding situation. Other studies have explored different interaction patterns that teams execute after a change has occurred. For instance, Stachowski et al. (2009) showed that high performing teams execute less complex verbal patterns than low performing teams when facing unexpected events. Relatedly, Uitdewilligen et al. (2018) demonstrated that teams who abandon previously established behavioral patterns and apply new ones adapt successfully to unexpected events.

Although empirical evidence provides some insight into the way teams adapt to unexpected events, it remains unclear whether the suggested sequential order of the four-phase team adaptation process leads to high team performance (Burke et al., 2006; Rosen et al., 2011). Building on the same data set that was used in this study, Georganta and Brodbeck (2018) investigated the relationships between single team adaptation phases and team performance and found positive correlations for each team adaptation phase and team performance. However, they did not investigate whether theoretically assumed sequences of team adaptation phases differentially influenced team performance. Therefore, we aim to extend this prior work by assessing all four phases of the team adaptation process and by exploring whether the complete four-phase sequence leads to high team performance. In our empirical study, we did not incorporate team emergent states - team emergent states being another component of the theoretical model of team adaptation (Burke et al., 2006; Rosen et al., 2011). Recognizing that team emergent states may be just as important as team processes, we singled out team processes for a first investigation of the entire sequence of the team adaptation process. Our study may serve as a starting point to guide future efforts to develop a more comprehensive theory of team adaptation, which addresses its dynamic nature in relation to team performance.

The Four-Phase Team Adaptation Process

Situation assessment, the first phase of the team adaptation process (Rosen et al., 2011), refers to the process of information gathering during which teams scan the environment for cues that possibly affect its goals, mission, and task execution. Specifically, team members monitor the environment, detect cues that disturb any ongoing processes, and try to estimate their meaning and consequences for the current situation to generate initial solutions (Burke et al., 2006; Gutwin & Greenberg, 2004). When facing a challenging event, teams need to first identify the cues that require an adaptive response and to reach a shared understanding of the environment and its demands to be able to prepare their subsequent steps. A clear understanding of the nature of the emergency represents an important prerequisite for effective teamwork (Bristowe, et al., 2012). Research supports the importance of situation assessment for the teams' success under demanding circumstances by showing that, for example, the time invested into cue identification and generation of responses is related to the subsequent success of team adaptation (Waller, 1999). Other empirical work also illustrates the positive impact of situation awareness on team planning behaviors (Garbis & Waern, 1999) as well as on effective decision-making (Wright & Endsley, 2008).

During plan formulation, the second phase of the team adaptation process (Rosen et al., 2011), teams set goals, decide on a course of action, formulate alternative plans, and clarify roles and responsibilities based on the current environmental demands and on previous actions (Burke et al., 2006; Stout & Salas, 1993). Specifically, teams generate a plan that supports their ability to adapt and achieve desired outcomes (Zajac, Gregory, Bedwell, Kramer, & Salas, 2014). Waller (1999), for example, showed that teams that engaged in planning behaviors outperformed teams who did not engage in similar actions when facing an unexpected event. Relatedly, Hertel, Geister and Konradt (2005) demonstrated that planning behaviors positively influence the subsequent coordinated information exchange and task execution.

After plan formulation, teams ideally continue on to the next phase, plan execution (Rosen et al., 2011). Plan execution represents the actual performance phase, where team members actively engage in a number of activities (mutual monitoring, communication, and back-up behaviors), aiming at successfully executing the plan formulated in the previous phase. Team members can coordinate their actions explicitly (e.g., communicating the following steps to the team members) as well as implicitly (e.g., relying on shared mental models to anticipate the needs of their teammates; Rosen et al., 2011). Empirical work showed that coordinated actions support teams' performance when there is a need to adapt (e.g., Entin & Serfaty, 1999).

The final phase of the team adaptation process is team learning (Rosen et al., 2011). Acknowledging that learning is a broad concept, we draw on the definition by Edmondson (2002), who specifies team learning as a "process in which a team takes action, obtains, and reflects upon feedback, and makes changes to adapt or improve" (pp. 129). During team learning, teams assess their status-quo, reflect on their previous actions, and develop a common understanding of their strengths and weaknesses (Otte, Konradt, & Oldeweme, 2018). Teams' goals in this phase are to improve their understanding of the current situation, to determine the consequences of previous adaptive actions, and to analyze how any unintended consequences could have been prevented (Rosen et al., 2011). As a result, teams can apply this knowledge in their upcoming actions and in future demanding situations (London, Polzer, & Omoregie, 2005). Current research supports that team learning behaviors, such as evaluation of previous performance and developing new strategies based on reflections of previous mistakes (cf. "lessons learned"), can encourage team adaptation and, in turn, increase team performance (Christian, Christian, Pearsall, & Long, 2017).

In summary, Rosen et al.'s theory (2011) supports two main assumptions on (1) how teams generally react after a change has occurred and (2) how teams should adapt in order to perform well. Specifically, Rosen et al. (2011) argued that when teams face unexpected demands, they will first try to understand the situation they are facing and then discuss and define how to further proceed. In this general team response to adaptive demands, teams could naturally vary in their team adaptation success. Rosen and colleagues argued that teams will be more successful in their response when they execute the team adaptation process comprising of all four team adaptation phases in the following order: situation assessment, plan formulation, plan execution, team learning. Hence, we propose the following:

Hypothesis 1: When adapting to an unexpected event, teams run through the sequences of the team adaptation phases as predicted by theory more often than through any other sequences of the same phases.

Hypothesis 2: When adapting to an unexpected event, high-performing teams run through the sequences of the team adaptation phases as predicted by theory more often than low-performing teams.

Methods

Participants

Our final data set contained 70 teams, each with four members (after excluding two teams due to poor sound quality of the video recordings). The majority of participants were students (92%), and 56% were female. Participants were, on average, 25.71 years old (*SD* = 7.23 years), and their national background varied (76% German, 13.7% other EU countries, and 10.3% non-EU countries). Participants were compensated with four Euros and could additionally earn up to 20 Euros based on their team's performance.

Procedure

In a laboratory study[1], 70 teams performed a simplified version of *Space Alert* (Heidelberger Verlag, 2008) — a space-themed board game — 5 times (one practice trial and four regular rounds). In each round, team members had to coordinate with each other under time

[1] The data for the current study were collected as part of a larger project. Data of the larger project were also used for another study that investigated team adaptation over time and focused on factors other than the ones used for the present study (e.g., multiple rounds, two different conditions). Only team performance was used in both studies. There was no other overlap between the two studies in terms of hypotheses or studied variables.

pressure to protect their spaceship and to eliminate an external threat. Each round consisted of up to seven 1-minute stages. During each stage, every team member could perform one action (i.e., attack, move, navigate, or load energy), while the external threat was also making steps toward the spaceship. If the external threat was not eliminated by the seventh 1-minute stage, the spaceship "exploded", and the team lost the entire round. The four regular rounds were independent from each other. All rounds were video-recorded.

The laboratory study[2] consisted of two conditions (not used in the present study): n = 35 teams were assigned to Condition A, and n = 35 teams were assigned to Condition B. The practice trial was the same for all teams. During the next three regular rounds, teams in Condition A experienced an unexpected event (reduction of available resources, loss of one team-member, or change in rules for operating the spaceship's guns). Teams in Condition B did not experience unexpected events while performing the first three regular rounds. At the beginning of the fourth regular round, both conditions faced the *same* unexpected event. The unexpected event was new to all teams and reflected "handling emergencies or crisis situations"(Pulakos, Arad, Donovan & Plamondon, 2000; p. 617) necessitating teams to adapt their strategies and ways of functioning. Specifically, teams had to respond with urgency to a threatening event and handle the danger appropriately in order to highly perform (also see Ployhart & Bliese, 2006).

For the present study, we focused on the fourth round only, using the data of the teams of both conditions A and B. As said before, during the fourth round, all teams had to adapt to the same new unexpected event. The fourth round was independent from the previous rounds. To ensure that the two conditions did not have an effect on one of our variables, we conducted preliminary analyses comparing the conditions for all our variables showing no differences between the two conditions. The comparison of the conditions is described in Appendix A. From this point forward, we refer to the fourth regular round of Space Alert as the "team task."

[2] The present study has received ethical approval from the ethical committee of the authors' institution.

Measures

Team adaptation phases. We first transcribed team member communication during task execution. Then, two raters (one of the authors and one research assistant familiar with the team adaptation literature) used the transcribed communication to code all incidents that contained information regarding the team adaptation phases. Video recordings were also used to interpret the transcripts to code nonverbal actions (e.g., team member attacking the external threat) and to interpret the transcripts. We decided to use parts or entire sentences as our unit of analysis due to the short task duration and time pressure.

We used the following criteria to code each unit: (a) units describing any actions, such as recognizing the unexpected change or communicating this information to the rest of the team, were coded as team actions when they impacted the team as a whole; (b) units that seemed relevant to more than one phase were viewed in relation to what the team discussed or did next; (c) actions that were observed on the video recordings and reflected on team adaptation phase but were not expressed verbally (e.g., attacking the external threat) were coded; (d) units that clearly reflected more than one phase were divided into shorter units so that each would reflect only one team adaptation phase; (e) units that were unrelated to the mission, such as information or questions related to the game itself were not coded; (f) when new information was assessed, it was coded as situation assessment, but when information was derived from experience (lesson learned) and then communicated to the rest of the team, it was coded as team learning. For each task round, the units were coded sequentially disregarding whether they occurred within or between 1-minute stages.

To code each unit to one of the four team adaptation phases, the raters used as a guideline, the Behaviorally Anchored Rating Scales (BARS) of the four-phase team adaptation process by Georganta and Brodbeck (2018). Specifically, the coding was based on the definition of each phase and the respective behavioral examples. For the definition of each phase and examples of the incidents coded, see Table 1.

Using the criteria above, the raters first coded the transcribed communication from six teams (i.e., 494 incidents) to achieve a common understanding of the coding. Initial interrater reliability for this step was good (Krippendorff's Alpha = 0.69) (Cicchetti, 1994). Interrater disagreements were discussed until a consensus was reached in all cases. Subsequently, both raters independently coded the remaining 64 teams. Interrater agreement for the remaining 2,740 incidents was excellent (Krippendorff's Alpha = 0.86). Here too, disagreements were resolved via discussion.

When two or more successive units were coded as the same phase, indicating that across those units the team remained in one phase, only one single code was assigned to all those units. After having summarized the codes where teams remained in one phase, the final number of coded phases across all teams was N=1,734 (*n* = 465 for situation assessment, *n* = 691 for plan formulation, *n* = 408 for plan execution, *n* = 170 for team learning).

Team performance. Team performance was assessed by a team's actual performance during the task. Team performance is expressed by the number of 1-minute stages a team completed. A team needs at least 3 out of 7 stages to complete the team task. We coded team performance as follows: 0 points = 0 stages completed, 1 point = 1 stage completed, 2 points = 2 stages completed, 3 points = 3 stages completed, 4 points = 4 stages completed. Thus, our dependent variable ranges from 0 (worst performance) to 4 (best performance). Teams achieved on average *M* = 3.12 points (*SD* = 0.86; Min = 0; Max = 4).

Data Analysis

We performed lag sequential analysis (Bakeman & Gottman, 1986; Bakeman & Quera, 2011; Kolbe et al., 2014) (a) to determine which sequences of team adaptation phases occurred more often than others (and more often than what would be expected by chance alone) and (b) to relate such patterns to team performance. To run the analyses, at least 153 coded phases were required to achieve at least five observations for each possible sequence of the team adaptation phases (i.e., cell; Bakeman & Gottman, 1986, p. 140). Furthermore, the analysis required that cells with less than five observed frequencies did not represent more than 20% of the cells (Tabachnik & Fidell, 2014). Our data fulfilled both criteria.

As a prerequisite to determine whether our hypotheses should be tested, we ensure that the teams executed the sequence of the team adaptation phases as predicted by theory more often than would be expected by chance. If this requirement was not met, testing our hypotheses would be unnecessary. We first tested whether the expected two-phase sequences occurred more often than would be expected by chance, before testing the three-phase sequence, and finally, the four-phase sequence. Two-phase sequences were tested using a 4 (phase 1 categories) × 4 (phase 2 categories) contingency table. Similarly, three-phase sequences were tested with a 4 (phase 1 categories) × 4 (phase 2 categories) × 4 (phase 3 categories) contingency table. Finally, four-phase sequences were tested using a 4 (phase 1 categories) x 4 (phase 2 categories) × 4 (phase 3 categories) × 4 (phase 4 categories) contingency table. For each contingency table, an overall log-linear analysis was performed and an adjusted residual *z* score was computed for each phase sequence, while taking into consideration the structural zeros (i.e., consecutive phases cannot repeat) as suggested by Bakeman and Quera (2011). Positive (or negative) z-scores indicate which particular phase sequences occurred more (or less) often than would be expected by chance alone.

After completing these preliminary analyses, we ran χ^2-tests to compare the frequency with which teams executed various phase sequences as predicted by theory to the frequency with which they executed other possible sequences of those same phases (cf. Hypothesis 1). We started by analyzing whether theoretically feasible two-phase sequences occurred more often than other possible two-phase sequences. Then we conducted the same analyses for three- and four-phase sequences. Finally, we compared the frequency with which high- and low-performing teams executed phase sequences as predicted by theory (cf- Hypothesis 2).

We performed log-linear analyses by using the standalone program for log-linear analysis Interactive Log-linear (ILOG, Version 4)) and χ^2 tests with the Chi-Square Test Calculator (Social Science Statistics, 2019).

Results

Preliminary Analyses

Before hypothesis testing, we first tested whether teams executed the sequence of the team adaptation phases as predicted by theory more often than would be expected by chance. Results showed that teams performed the expected two-phase sequences situation assessment → plan formulation (z = 2.55), plan formulation → plan execution (z = 3.63) and team learning → situation assessment (z = 2.17) more often than would be expected by chance alone. Plan execution → team learning was executed as often as expected by chance (z = 0.96). Regarding the three-phase sequences, results indicated that teams performed situation assessment → plan formulation → plan execution (z = 1.00) and plan execution → team learning → situation assessment (z = 2.05) more often than would be expected by chance alone. However, plan formulation → plan execution → team learning (z = 0.11) and team learning → situation assessment → plan formulation (z = 0.47) were executed as often as expected by chance. Finally, the expected four-phase sequences plan formulation → plan execution → team learning → situation assessment (z = 1.02) and plan execution → team learning → situation assessment → plan formulation (z = 1.02) were executed more often than would be expected by chance alone. However, results showed that teams performed situation assessment → plan formulation → plan execution → team learning (z = 0.33) and team learning → situation assessment → plan formulation → plan execution (z = 0.22) as often as expected by chance.

Comparing the predicted phase sequences to any other phase sequences

Hypothesis 1 predicted that the phase sequences as proposed by theory would occur significantly more often than *any other* sequences of the same phases. When testing Hypothesis 1 and running the respective χ^2 analyses, the number of the comparing phase-sequences was considered. For instance, when comparing situation assessment → plan formulation with situation assessment → plan execution and situation assessment → team learning, we considered that we compared 33.33% with 66.66% of the observed two-phase sequences. We started by exploring the two-phase sequences that were executed more often than would be expected by chance alone and then continued with the three- and four-phase sequences.

Two-phase sequences. Regarding two-phase sequences starting with situation assessment, results showed that situation assessment → plan formulation occurred 75.69% of the time and significantly more often than situation assessment followed by all other team adaptation phases combined (χ^2 (1) =375,57, $p < .001$), as expected. Opposite to expectations, plan formulation → plan execution occurred 44.76% of the time and significantly less often than plan formulation followed by all other team adaptation phases combined (χ^2 (1) = 40.47, $p < .001$). Similarly, team learning → situation assessment occurred 9.27% of the time and significantly less often than team learning followed by all other team adaptation phases combined (χ^2 (1) = 89.85, $p < .001$). Hence, when looking at two-phase sequences, Hypothesis 1 was only supported for the sequence situation assessment → plan formulation.

Three-phase sequences. Regarding three-phase sequences starting with situation assemment, situation assessment → plan formulation → plan execution occurred 36.08% of the time and significantly less often than situation assessment followed by all other possible two-phase sequences combined (χ^2(2) = 283.43, $p < .001$), in contrast to expectations. Simlarly, plan execution → team learning → situation assessment occurred 2.93% of the time and significantly less often than plan execution followed by all other possible two-phase sequences combined (χ^2 (2) = 23.07, $p < .001$). Results also showed that plan formulation → plan execution → plan formulation as well as plan formulation → situation assessment → plan formulation occurred 57.62% of the time and significantly more often than plan formulation followed by all other possible two-phase sequences combined (χ^2(2) = 470.68, $p < .001$), in contrast to our expectations. Thus, when looking at three-phase sequences, Hypothesis 1 was not supported.

Four-phase sequences. Given that our Hypothesis 1 was only confirmed for situation assessment → plan formulation, we did not continue testing the four-phase sequence.

For the frequencies for all possible two-phase sequences see Table 2. For the frequencies for all possible three- and four-phase sequences see Supplemental Material.

Comparing phase sequences between high- and low-performing teams

Hypothesis 2 predicted that when adapting to an unexpected event, high-performing teams execute the phase sequences as proposed by theory significantly more often than low-performing teams. To distinguish high- from low-performing teams, we used a 20-percentile split of team performance. Similar splits have been applied in previous studies (e.g., Bowers, et al, 1998; Grote et al, 2010). Fourteen teams were in the bottom 20th percentile (i.e., team performance < 3; M = 1.79, SD = 0.15) and 27 teams were in the top 20th percentile (i.e., team performance > 3; M = 4.00, SD = 0.00), differing significantly in their team performance ($t(39) = -20.11$, $p = .010$). When testing Hypothesis 2 and running the respective χ^2 analyses, the different size of high- and low-performing teams (65% versus 35% of sample size) was considered.

Two-phase sequences in high-performing versus low-performing teams. In contrast to expectations, situation assessment → plan formulation was executed significantly less often in high-performing teams than in low-performing teams ($\chi^2(1) = 8.29$, $p < .001$). Further, plan formulation → plan execution ($\chi^2(1) = 9.53$, $p < .001$) was executed significantly less often in high- than in low-performing teams. The execution of plan execution → team learning ($\chi^2(1) = 0.20$, $p = .654$) and team learning → situation assessment ($\chi^2(1) = 2.45$, $p = .117$) did not differ significantly between high- and low-performing teams, contrary to expectations. In high-performing teams, results also showed that team learning → situation assessment was significantly less often executed than team learning → plan formulation and team learning → plan execution ($\chi^2(1) = 4.17$, $p = .041$), whereas in low-performing teams, team learning → situation assessment was significantly more often executed than team learning → plan formulation and team learning → plan execution ($\chi^2(1) = 10.54$, $p < .001$), findings that were not expected. Thus, Hypothesis 2 was not supported when looking at two-phase sequences.

Three-phase sequences in high-performing versus low-performing teams. Contradicting our assumptions, situation assessment → plan formulation → plan execution was executed significantly less often in high- than in low-performing teams ($\chi^2(2) = 12.50$, $p < .001$). Plan formulation → plan execution → team learning ($\chi^2(2) = 0.09$, $p = .952$), plan execution → team learning → situation assessment ($\chi^2(2) = 1.48$, $p = .477$), and team learning → situation assessment → plan formulation ($\chi^2(2) = 4.07$, $p = .130$) did not significantly differ between high- and low performing teams, in contrast to expectations. Thus, Hypothesis 2 was not supported when looking at three-phase sequences.

Four-phase sequences in high-performing versus low-performing teams

Given that Hypothesis 2 was not supported for two- and three-phase sequences, we did not continue testing the four-phase sequence.

For the frequencies for all possible two-phase sequences see Table 3. For the frequencies for all possible three- and four-phase sequences see Supplemental Material.

Discussion

The purpose of our study was to examine the way teams adapt when confronted with an unexpected change during the execution of their team task under controlled conditions. Furthermore, our aim was to understand why some teams adapt more effectively than others. We, therefore, investigated whether the execution of the team adaptation process as a four-phase sequence — as proposed by Rosen et al. (2011) — supported team performance. However, only situation assessment was followed – consistent with theory – by plan formulation when facing an unexpected event. Contradicting our expectations, teams also performed phase sequences not in line with theory, moving not only forward but also backward to previous phases (“forward-backward” sequences). Further, high-performing teams did not execute theoretically postulated phase sequences more often than low-performing teams; differences between high- and low-performing teams were related to phase sequences other than the ones that the theory suggests. Specifically, high-performing teams were less likely to follow the theoretically proposed sequence than low-performing teams, suggesting that they might be more flexible when adapting. Overall, the team adaptation process (Burke et al., 2006; Rosen et al., 2011), with respect to the investigated phase sequences, did not fully reflect the way teams (successfully) adapted to an unexpected event.

Contradicting team adaptation theory (Rosen et al., 2011), team learning was followed not only by situation assessment but also by plan formulation and plan execution. These findings point out that teams do not only learn toward the end of the team adaptation process but also at different points in time during the same team adaptation process. As Schmutz, Lei, Eppich, and Manser (2018) relatedly showed, learning behaviors such as team reflection often take place during performance episodes "focused on immediate and direct implications for the 'here and now' " (pp. 751). It seems that teams evaluate and reflect on their past actions multiple times, and that the knowledge gained guides their next immediate steps (Rench, 2014; Santos et al., 2016). These findings are in line with approaches to learning as a process (Savelsbergh, van der Heijden, & Poell, 2009) and empirical evidence, suggesting that reflecting on team actions, questioning goals, and recognizing mistakes and weaknesses influence various team processes (e.g. Van den Bossche, Gijselaers, Segers, & Kirschner, 2006). Team learning "comprises the process of acquiring knowledge through experience, which leads to a change in behavior" (Buchanan & Huczynski, 1997; p.107). Hence, team learning is not only limited to scanning behaviors (i.e., situation assessment) while adapting, but also applies to any aspect of a team's overall functioning, including plan formulation and plan execution.

In a related vein, results illustrated that after plan formulation, teams moved on to plan execution and then moved back to plan formulation instead of moving "forward" to team learning. One possible explanation for this "forward-backward" sequence is that after plan execution, teams went "back" to a different type of planning (e.g., reactive planning) compared with the previous planning phase (e.g., contingency planning). While executing their original plan, teams may have realized that some further adjustments were necessary, such as redistribution of roles and responsibilities, and, therefore turned "back" to plan formulation to adjust their originally planned strategy. In particular, reactive planning describes a team's on-the-fly planning in response to changing circumstances (Marks et al., 2011), whereas deliberate or contingency planning takes place right at the beginning of task performance (DeChurch & Haas, 2008).

"Forward-backward" sequences might also be interpreted in terms of "reflection-in-action" phases (Schön, 1983). Contrary to expectations, differences in team performance were not related with phase sequences as suggested in the team adaptation process model (Burke et al., 2006; Rosen et al., 2011) and as empirically identified by van den Heuvel et al. (2014) in the context of hostage negotiations. Our findings demonstrated that high-performing teams, for instance, executed significantly more often team learning followed by plan formulation and team learning followed by plan execution (instead of team learning followed by situation assessment) compared with low-performing teams. The results imply that the evaluation that took place during team learning resulted in different conclusions for high-performing than for low-performing teams. It seems that high- and low-performing teams held different views regarding where the team stands, and consequently, how it should proceed. As Rench (2014) has argued, the feedback received during team learning has an impact on which previous phase a team will shift back to. High-performing teams shifted back to planning and execution, perhaps to change their strategy, to reframe their goal, or to apply the lessons learned directly into action (i.e., plan execution). Low-performing teams shifted back to situation assessment possibly because they realized that the situational cues originally collected were insufficient for gaining a complete picture of the facing unexpected event. It is possible that low-performing teams did not diagnose their situation sufficiently after the unexpected event was introduced. Oppositely, high-performing teams may have gained a better picture of the unexpected event and incorporated this information directly in their subsequent plans and actions. In van den Heuvel et al.'s (2014) work, the theory-conform team adaptation sequences executed by high-performing teams might be explained by the setting in which these teams operated. It is possible that police officers in hostage negotiation situations might be trained to proceed in a standard way no matter how challenging or unexpected the situation might be. These teams may have specific operating procedures and clear protocols that guide their behavior and do not allow for any deviation in order to reduce uncertainty and risk and thereby successfully adapt.

Overall, our findings question the assumption of the fixed four-phase sequence of the team adaptation process proving an opportunity to refine the team adaptation theory (Burke et al., 2006; Rosen et al., 2011) and guide future research. Specifically, results suggest that the team adaptation process should incorporate flexible phase-sequences, as teams run through team adaptation phases multiple times when there is a need to adapt. For instance, the role of the team learning phase could be revisited, given that teams executed team learning throughout the process of team adaptation and not only at its completion. Further, the equal importance of the team adaptation phases should be discussed, given the evidence for micro-cycles (e.g., plan formulation → plan execution → plan formulation) that may signal the greater role of specific phases (e.g., plan formulation) for team performance. As Maynard et al. (2015) have highlighted, "under severe situations, the team may in fact have to go back and revisit its transition processes before adapting either its action or interpersonal processes." (p. 2).

Limitations

Although laboratory studies allow addressing theoretical assumptions while minimizing extraneous effects, we believe that future research should investigate the team adaptation phases and their executed sequences within an organizational setting to test the generalizability of our findings. Furthermore, we believe that future studies should explore these team adaptation phases within a longer team task. In the present study, teams may not have been able to execute specific team adaptation phases, such as team learning, to a great extent. Future studies should investigate whether due to high pressure, some teams, such as medical emergency teams need to skip or perform specific team adaptation phases (e.g., team learning) in order to adapt successfully. As researchers have argued, the speed of team adaptation may need to be adjusted according to the task demands and to the time available (Burke et al., 2006; Kozlowski et al., 1999).

Future studies should also investigate whether the duration of the executed phases and phase-sequences has an impact on team performance, an aspect that we did not investigate given the short nature of the team task. For instance, future studies could investigate whether teams who spend more time in situation assessment (resulting in a clearer picture of the situation) adapt more successfully to unexpected demands than teams who briefly collect some relevant information and then move directly to plan formulation. Future research should also explore whether some team adaptation phases (e.g. situation assessment) or phase-sequences become more or less important over time. Such temporal and severity features need to be investigated in order to specify the level of granularity of these phases, an aspect that has been so far neglected by both team adaptation theory and research (Maynard et al., 2015).

Another boundary condition that should be considered when planning future research is that we neglected the content of the performed team adaptation phases, as we captured only whether the team adaptation phases were executed (or not). For instance, the multidimensionality of team planning was neglected, although research suggests that the type of team planning can influence team performance (DeChurch & Haas, 2008). Further, the specific content of the lessons learned (i.e., team learning), for instance, how this was related to the teams' following decisions and whether this was related to completing parts of the task (i.e., micro-cycles of learning) or the task as a whole was not investigated. We suggest future research to explore this information in order to provide more insight into the impact of team learning and other team adaptation phases on future team adaptation. Finally, we focused only on the team processes involved in each team adaptation process phase, neglecting that team emergent states also contribute to successful team adaptation (e.g., Christian et al., 2017). Hence, we suggest future studies to investigate both team adaptation phases (incorporating all team processes) and team emergent states to extend the present findings and fully comprehend the relationship between the team adaptation process and team performance.

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Table 1
Definitions of Team Adaptation Phases and Examples of Statements

Team Adaptation Phase	Definition	Examples
Situation Assessment	During situation assessment, the team members scan the environment to gather information, to identify relevant cues and to recognize the significance of the cues. This phase evokes increased awareness of the information that concerns the team's goals, mission, or accomplishment of the team task. During situation assessment, the team tries to gauge the consequences of the current situation.	"It (the threat) has still five life points." "Exactly, one of the two guns is not blocked.'
Plan Formulation	During plan formulation, the team develops a plan of action. The team prioritizes its actions, sets goals, and clarifies the team roles and responsibilities within the course of action.	"You should move to the bottom, I will stay here and you should move to the right so we can shoot from there during the next round." "We should shoot first so then we can load with energy the top of our spaceship."
Plan Execution	During plan execution, the plan is executed in order to achieve the team's goal. Plan execution involves behaviors such as monitoring, communication, leadership and coordination.	"I am loading energy." "We are shooting together to damage the threat."
Team Learning	During team learning, team members reflect on results, discuss and learn from their own successes, errors and/or unexpected outcomes. The team discovers the consequences of previous actions, the mechanisms by which unintended consequences can be prevented and the manner in which courses of action can be revised.	"I think that we should do it as before, as last time it worked out well." "I cannot shoot from here. We did it all wrong."

Note. Definitions based on the BARS-scales by Georganta and Brobeck (2018).

Table 2

Z Values for the Two-Phase Team Adaptation Sequences

	Consequence 1							
	Situation Assessment		Plan Formulation		Plan Execution		Team Learning	
Antecedent	*z*	*n*	*z*	*n*	*z*	*n*	*z*	*n*
Situation Assessment	-	-	2.55	352	-5.48	63	2.19	50
Plan Formulation	-2.08	295	-	-	3.63	308	-2.10	85
Plan Execution	1.90	102	-1.70	211	-	-	0.96	32
Team Learning	2.17	48	-1.71	84	0.37	33	-	-

Note. *N* = 70 Teams.

Table 3

Z Values for the Two-Phase Team Adaptation Sequences for High- and Low-performing Teams

	Consequence 1							
	Situation Assessment		Plan Formulation		Plan Execution		Team Learning	
Antecedent	*z*	*n*	*z*	*n*	*z*	*n*	*z*	*n*
High-performing Teams								
Situation Assessment	-	-	1.14	119	-3.18	23	1.93	24
Plan Formulation	-0.21	106	-	-	1.84	102	-2.20	32
Plan Execution	0.56	33	-1.02	70	-	-	1.35	16
Team Learning	-0.29	15	-0.36	38	0.87	16	-	-
Low-performing Teams								
Situation Assessment	-	-	1.33	95	-3.05	15	1.44	12
Plan Formulation	-1.69	76	-	-	2.55	86	-1.17	19
Plan Execution	0.65	26	0.56	61	-	-	-0.32	7
Team Learning	3.37	16	-1.46	17	-1.28	4	-	-

Note. *N* = 27 High-performing Teams, *N* = 14 Low-performing Teams.