Police Dyads Within an Operational Simulation: an Empirical Test of the Research Propositions Made in the "Big Five" Teamwork Approach

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Abstract

Based on the impact of the theoretical big five of teamwork model proposed by Salas et al. (2005), the present study aimed at investigating the model within an operational police simulation. One hundred and sixty-seven frontline police officers participated in the study. Based on path analyses, a reduced model excluding trust and leadership obtained a good fit with the data. The results provided some support for the model by confirming six out of 10 proposed direct effects and four out of seven indirect pathways. Shared mental models directly affected team adaptability, and backup behavior affects adaptability and team effectiveness. Team orientation affects mutual performance monitoring and backup behavior, and finally, reciprocal monitoring affects backup behavior. Monitoring influenced both team effectiveness and adaptability through backup behavior. Two paths from team orientation towards effectiveness were found. One flowing through monitoring and another through back-up behavior. Our study expands former knowledge of the big five theory by empirically testing the totality of the model and identifying important pathways.

Keywords Shared mental models · Closed loop communication · Mutual trust · Team leadership · Team orientation · Mutual performance monitoring · Back-up behavior · Adaptability

Introduction

There is an abundance of evidence showing that teams and team behavior are driving forces for working group effectiveness. As an example, Parker et al. (2017) concluded in a meta-analysis of work design that (semi-) autonomous work groups (i.e., teams) were one of five key perspectives when looking back on 100 years of research. Despite the overwhelming amount of research into teams and team behavior, no consensus has been reached on the mechanisms involved when teams show superior performance. Some theories emphasize differences in cognition and information within the team (e.g., transactional memory systems; Yoo and Lee 2008), while others focus on the sharedness of

cognition and information. Over the last decades, attention has turned to the theory of shared mental models (SMMs; Cannon-Bowers et al. 1993) as an important advocate for the latter position. A great profusion of research over the last three decades has shown that this theoretical position can explain the increased effectiveness of expert teams (e.g., Mathieu et al. 2000; Espevik et al. 2006; Westli et al. 2010, Johnsen et al. 2017). A mental model is thought of as organized knowledge structures which describe, explain, and predict the status of a system (Langan-Fox et al. 2000; Smith-Jentsch et al. 2001). SMMs will enhance the implicit coordination, the appropriation of new or edited models if the existing model is maladaptive, the sustainability of the team, and, finally, the production of results. The theory was further developed by Salas et al. (2005), who, after reviewing two decades of team literature, suggested a theory of teamwork consisting of three coordinating mechanisms and five team processes associated with the success of teams. The purpose of the coordinating mechanisms was to safeguard the updating and distribution of relevant information. The three coordinating mechanisms were SMMs, mutual trust, and closed loop communication (CLC). The five team

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processes were team leadership, mutual monitoring, backup behavior, team orientation, and adaptive abilities.

SMMs were described (Salas et al. 2005) as a shared understanding of team goals, the individual team members' role, and the coordination towards the team goal. Trust was defined as a belief that the team members would perform expected actions and recognize and protect the interests of their colleagues (Salas et al. 2005). According to the authors, this includes a willingness to be exposed to the risk caused by members working interdependently. This has similarities with other definitions of trust as a willingness or intention to appear vulnerable to the consequences of others' decisions or behavior, because one expects these to be well-intended (Mayer et al. 1995). The purpose of the third coordinating mechanism, CLC, is to prevent misunderstandings and to make sure the information is perceived correctly. CLC involves sending information from a sender to a recipient, with the recipient perceiving and acknowledging the message and relaying their understanding back to the sender. A loop is thereby created to ensure that a shared understanding is established (hence, communication, which is derived from the Latin verb *communico*, meaning to make common).

Behavioral markers of the team process of leadership are to define goals, correct deviance, delegate and coordinate activities, and motivate and evaluate team behavior (Salas et al. 2005; Zaccaro et al. 2001). Examples of team adaptation are the members' ability to detect changes in the situation and adjust behavior accordingly. Mutual performance monitoring is characterized as team members' attention to the performance of other team members, in parallel with their own behavior. The intention of monitoring is to ensure the team's progression towards the goal, as well as the accuracy of performance. Back-up behavior is defined as a reciprocal willingness to support team members when they are overloaded, thereby ensuring an even workload distribution. Team orientation is directed towards a preference for freely sharing information, as well as the use of or building on others' suggestions and performance.

Since Salas et al. presented their model in 2005, few studies have empirically tested the complete model. One exception is a study of nursing teams using a qualitative method (Kalisch et al. 2009). In their study of teams from a variety of nursing professional domains (emergency, maternity, and intensive care units), focus groups, including probing questions, were used. The questions were concentrated on both the coordinating mechanisms and the five team processes proposed by Salas et al. (2005). According to Kalisch et al. (2009), they found support for the model. In a quantitative study, McComb et al. (2017) studied the two coordinating mechanisms of SMMs and trust. However, the focus of their study was to test for group differences between nurses and physicians. They found a significant difference in perceived role responsibilities between nurses and physicians, thereby

indicating low SMMs. The results also revealed that nurses and physicians showed an equal level of trust towards physicians, but the physicians rated the trust level towards nurses lower compared to the nurses' evaluation of trust towards their own profession. Although the McComb et al. (2017) study tested both the mechanism of SMMs and trust, it did not include all mechanisms and team processes described in the model.

Study Aims

Based on the impact of the theoretical model proposed by Salas et al. (2005) on both research and practice, as well as the lack of empirically quantitative testing of the complete model, the present study aims at investigating the model within an operational police simulation. This includes all research propositions suggested by Salas et al. (2005). Since the focus of the study is the suggested model and its propositions, the individual elements' association with performance was considered to lie outside the scope of the present study. The Salas et al. (2005) article describes several "high-level relationships" among the coordinating mechanisms. These are "Big Five" team processes and team effectiveness, as well as ten research propositions. Both the high-level relations and the research proposals could be viewed as unidirectional causal pathways. Furthermore, the proposed model describes the "Big Five" team processes as being spaced between the coordinating mechanisms and output of the team. The causal direction thus flows from the coordinating mechanism, through the big-five team processes, and onto team effectiveness. This causal flow makes the model suitable for testing using path analyses.

The high-level relationships and research propositions outlined in Salas et al. (2005) can also be used to derive a series of specific hypotheses about the relationships between the coordinating mechanisms, team processes, and team effectiveness:

> Hypothesis 1a: SMMs directly affect mutual performance monitoring.
> Hypothesis 1b: SMMs directly affect back-up behavior.
> Hypothesis 1c: SMMs directly affect team adaptability.
> Hypothesis 2a: Back-up behavior directly affects team adaptability.
> Hypothesis 2b: Back-up behavior directly affect team effectiveness.
> Hypothesis 3a: Team orientation directly affects mutual performance monitoring.
> Hypothesis 3b: Team orientation directly affects back-up behavior.
> Hypothesis 4: A climate of trust directly affects mutual performance monitoring.

Hypothesis 5: Mutual performance monitoring directly affects back-up behavior.
Hypothesis 6: Team adaptability directly affects team effectiveness.

The ten research propositions described in Salas et al. (2005) may furthermore entail some indirect relationships in addition to the direct relations proposed above:

Hypothesis 7a: Team leadership has an indirect effect on team effectiveness through its influence on back-up behavior.
Hypothesis 7b: Team leadership has an indirect effect on team effectiveness through its influence on mutual performance monitoring, which in turn influences back-up behavior.
Hypothesis 8a: Mutual performance monitoring has an indirect effect on team effectiveness through backup behavior.
Hypothesis 8b: Mutual performance monitoring has an indirect effect on team adaptability through its influence on back-up behavior.
Hypothesis 9a: Team orientation has an indirect effect on team effectiveness through its influence on mutual performance monitoring.
Hypothesis 9b: Team orientation has an indirect effect on team effectiveness through its influence on back-up behavior.
Hypothesis 10: Back-up behavior has an indirect effect on team effectiveness through its influence on team adaptability.

In Norway, police officers normally operate in pairs. Together, they may face uncertain and unclear situations, with devastating consequences if they make the wrong call. The "Big Five" behaviors and coordinating mechanisms are claimed to respond to this. An evolving police mission could enable the two police officers involved to establish and update SMMs, show trusting behavior, exercise CLC, coordinate their behavior, monitor and support each other, and adapt to the situation. A limited, simulated, and realistic mission situation also allows us to register visual and verbal signs for all eight behaviors and how well they perform. Police dyads on a mission thus provide an excellent means of investigating the "Big Five" approach.

Method

Subjects

The present study used the same sample as presented in an earlier study (Johnsen et al. 2017). One hundred and sixty-six frontline police officers participated in the study. The age distribution of the participants was 4.7% below 25 years, 23.5% between 25 and 29 years, 41.2% between 30 and 39 years, and 28.8% between 40 and 57 years, while 1.8% lacked data for this variable. All subjects had passed the standard annual tests and were cleared for operational duties. Their operational experience ranged from less than 1 year to 20 years, with the majority (42.6%) reporting between 6 and 10 years of operational police service (Johnsen et al. 2017). The sample was recruited from the west coast of Norway and consisted of personnel from both urban and rural areas, as well as different types of main functions (investigation, patrol, organized crime, K9, etc.).

Questionnaires

Based on Salas et al. (2005)'s definition of the "Big Five" teamwork behaviors and the three coordination mechanisms, a questionnaire for the observer rating by subject matter experts (SMSs) was developed. Two SMEs initially rated all "Big Five" behaviors and coordinating mechanisms independently, and after each simulation, they made a consensus-based decision for the patrol.

All items presented to the participants were scored on a seven-point Likert scale (very low to very high). The rankings of scores were defined as unacceptable performance (scored 1); performance lower than standard (scored 2 or 3); expected level of performance meets standards (scored 4); above standard (scored 5 or 6), and exceptional performance (scored 7).

Shared Mental Models

SMMs were measured by the question: The team created a shared understanding of the mission (kept each other updated on the target, the situation and priorities, and the needs from both internally within the team and towards external parties).

Trust

Scores on trust were obtained from the question of how far the team trusted each other (understanding and acceptance of suggestions aimed at improving the performance, and not motivated by selfish reasons).

Closed Loop Communication

CLC was scored based on the question of to which degree the team exchanged information and coordinated their activities by means of verbal feedback.

Team Leadership

The standard procedure in the Norwegian police is for the most experienced officers in the patrol to take a leadership role, unless decided otherwise. In the present study, leadership was rated by how the leader established a common understanding of goals, expectations of team behavior and performance (through intentions, and coordination of responsibilities and resources).

Mutual Performance Monitoring

This team process was rated by the question of how the team members monitored each other's performance (the team members offered and accepted feedback about errors).

Back-Up Behavior

In order to score support behavior, the observers rated the team for the item of how the team showed supportive behavior (offered help without being asked, and avoided overburdening team members).

Adaptability

This process was measured by the single item of how the team adapted to the situation (coordinated in order to meet altered internal and external needs).

Team Orientation

Attitudes towards teamwork were rated by means of the question of whether the team showed an ability to maintain the best possible understanding of the situation (an orientation towards combining analyses, new information and the use of experience, and police culture in order to create the best possible understanding of the situation).

Team Effectiveness

The output variable of team effectiveness was measured by a composite score of three items (range 3 to 21). Scores for *decision-making* were obtained from the question: "The team evaluated different alternatives for action (according to mission, available time and resources)." The second question included in team effectiveness was: "The team showed an ability to act (proactive, good strategy and procedure, timely and precise)." The third item of this measure was *mission success*. This item consisted of the question: "The team was successful in their mission (regarding the target of the training)."

Procedure

Before the start of the study, the participants read and signed an informed consent statement. They were informed that they could withdraw from the study at any time during or after the study. No participant withdrew from the study.

Test Scenario

The situation constructed for the study was a simulated operational police scenario. The simulation was conducted using a standard set-up for Norwegian police patrols, which consist of two officers. The team members were not familiar with each other (i.e., did not normally patrol together). The simulation started with the team members seated in the patrol car, receiving a description of the situation and the instructions. The instructions were given as a dispatch report describing an armed robbery involving a knife. The perpetrator was observed by an undercover agent entering a hostel known for housing several previously convicted persons. The mission given from the dispatch was to approach and guard the back door of the hostel, while another unit attempted to arrest the suspect, by entering from the front door. The team was given 5 min to simulate the transit time to the hostel. After positioning themselves at the back door, a person would exit here. This person was similar to the description of the perpetrator, except for two features (grey vs. black pants, and holding a short umbrella vs. a knife). The second person exiting 30 s later was identical with the description of the perpetrator. Both persons had to be handled by the police officers.

Scoring of Responses

Two experienced police officers attached to the training wing, who were also engaged in the regional police training on a daily basis, were used as subject matter experts (SME). Each of the SME had more than 20 years' service in the police force. Instructors attached to the training wing held this role on the basis of their knowledge of police tactics and their ability to observe and guide colleagues (see Lavin et al. 2007, for critical discussion of the use of SME). The leaders of the training wing were also involved in designing the study, including the variables used. The same SME observed and rated all 83 simulations. The SME were located in the same room, about 10 feet from the participants, with no obstruction of their view of the scenario. However, one exemption from this was the driving phase, which for practical reasons, the observers were unable to observe. The ratings were conducted immediately after each

team's execution of the mission. The observers conducted their own evaluation first, followed by a consensus evaluation. The analyses are based on the consensus scores. Since the simulation was performed as part of the annual training, the presence of the SME following the execution of the scenario was consistent with standard training procedure.

Statistics

A path analysis was used to test the model and the different pathways proposed in Salas et al. (2005). Figure 1 presents the proposed hypotheses and relationships between the team processes and the coordinating mechanisms. The coordinating mechanisms are depicted in shaded rectangles, while the team processes are shown in unshaded rectangles with bold lettering.

The specific indirect effects specified by the propositions (Hypotheses 7–10) were tested by multiplying the path coefficients for the variables involved and then computing bootstrapped confidence intervals for the indirect effects (i.e., the products). We chose this strategy, instead of estimating normal theory-based test statistics (Z-values), due to

the known irregularities of the sampling distribution of the indirect effect (Hayes 2018; MacKinnon et al. 1995). In our analysis, 1000 replications were used to estimate 95% confidence intervals. From each replication, an indirect effect is computed and then an empirical sampling distribution is generated. From this distribution, a confidence interval is computed. If it does not contain zero, this supports the conclusion that an indirect effect exists (Hayes 2018).

All analyses were performed using the statistical software Stata, version 16 (StataCorp 2019).

Assessment of Model Fit

The overall fit of our model was evaluated using several commonly used fit indices for structural equation modeling, including the chi-square, root mean square error of approximation (RMSEA), standardized root mean-squared residual (SRMR), and the comparative fit index (CFI). Values for CFI range from 0 to 1 and are derived from the comparison of a hypothesized model with the independent model, with a value greater than 0.90 indicating an acceptable fit, and a value equivalent to or above 0.95 indicating a good fit

Fig. 1 Proposed hypotheses and relationships between team processes (rectangles with bold lettering) and coordinating mechanisms (shaded rectangles)
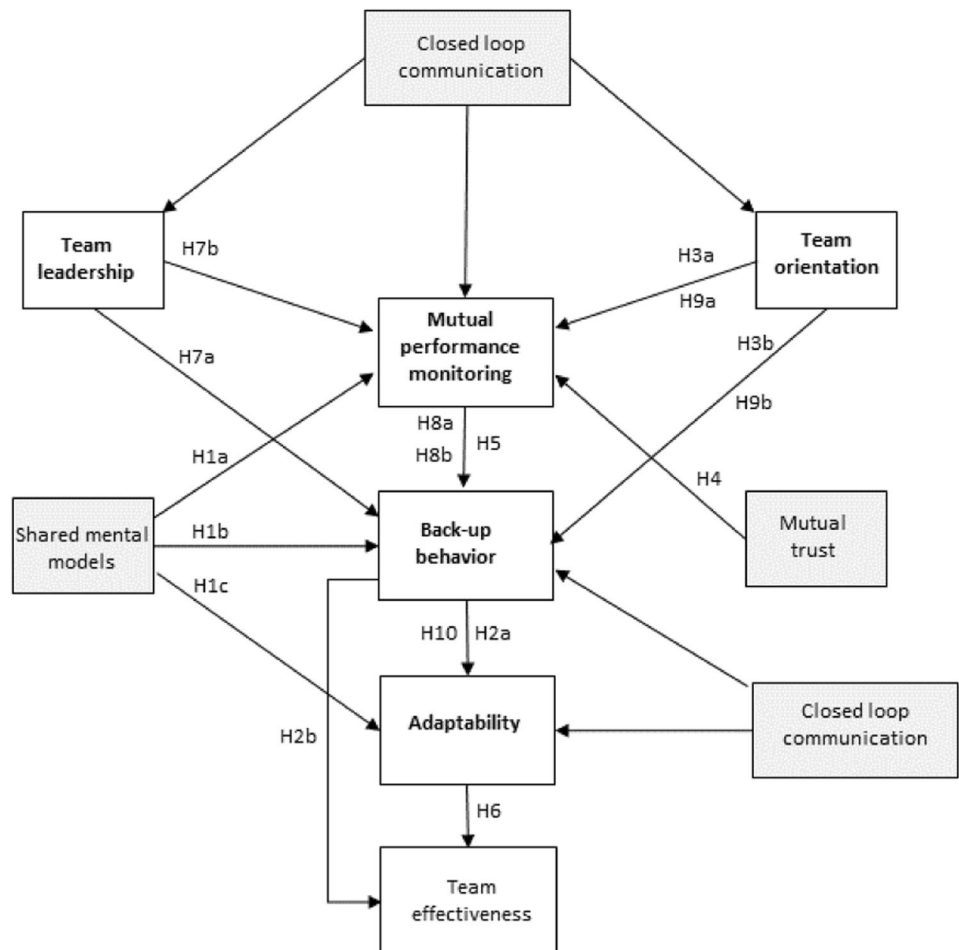
to the data (Hu and Bentler 1999; Kline 1998; McDonald and Ho 2002). By convention, a RMSEA value less than or equal to 0.05 is considered a good fit, and a value less than or equal to 0.08 is considered an adequate fit (Kline 1998; MacCallum et al. (1996);. Correspondingly, a value less than 0.08 for SRMR is generally considered a good fit (Hu and Bentler 1999).

Results

The full model depicted in Fig. 1 did not have a good fit with the data with a $\chi^2(16) = 124.412$ ($p < 0.001$), $RMSEA = 0.289$, 90% CI for $RMSEA = 0.243$–0.338, $SRMR = 0.079$, and a $CFI = 0.86$. Team leadership was not related to either performance monitoring ($\beta = -0.07$, $p = 0.60$) or back-up behavior ($\beta = -0.08$, $p = 0.41$), and thus Hypotheses 7a and 7b are not supported. The results furthermore show that trust did not predict mutual performance monitoring ($\beta = 0.03$, $p = 0.84$). Hypothesis 4 is therefore not supported either.

Since team leadership and mutual trust were not related to any other variable, we re-specified our model with these two variables omitted. This reduced model was a better fit for the data according to $SRMR = 0.049$ and a $CFI = 0.95$. However, the $\chi^2(7) = 37.076$ was still statistically significant ($p < 0.001$) and the $RMSEA = 0.230$ indicated a poorly fitting model. The reduced model is shown with standardized regression coefficients in Fig. 2. The reduced model included the coordinating mechanisms of SMMs and CLC, as well as the team processes of mutual performance monitoring, back-up behavior, and adaptability. The significant direct pathways were CLC towards mutual performance monitoring and adaptability. Hypotheses 1a through 1c proposed that SMMs directly affect performance monitoring, back-up behavior, and adaptability. As can be seen from Fig. 1, only Hypothesis 1c was supported: SMMs had a statistically significant direct effect on team adaptability ($\beta = 0.36$, $p < 0.001$), but not performance monitoring or back-up behavior. Figure 2 furthermore shows that back-up behavior had statistically significant direct effects for both adaptability ($\beta = 0.27$, $p < 0.01$) and team effectiveness ($\beta = 0.49$, $p < 0.001$), supporting our Hypotheses 2a and 2b. The path from adaptability to effectiveness was not statistically significant, however, ($\beta = 0.22$, $p = 0.14$), contrary to Hypothesis 6.

Fig. 2 Reduced model with standardized regression coefficients. ***$p < 0.001$, **$p < 0.01$
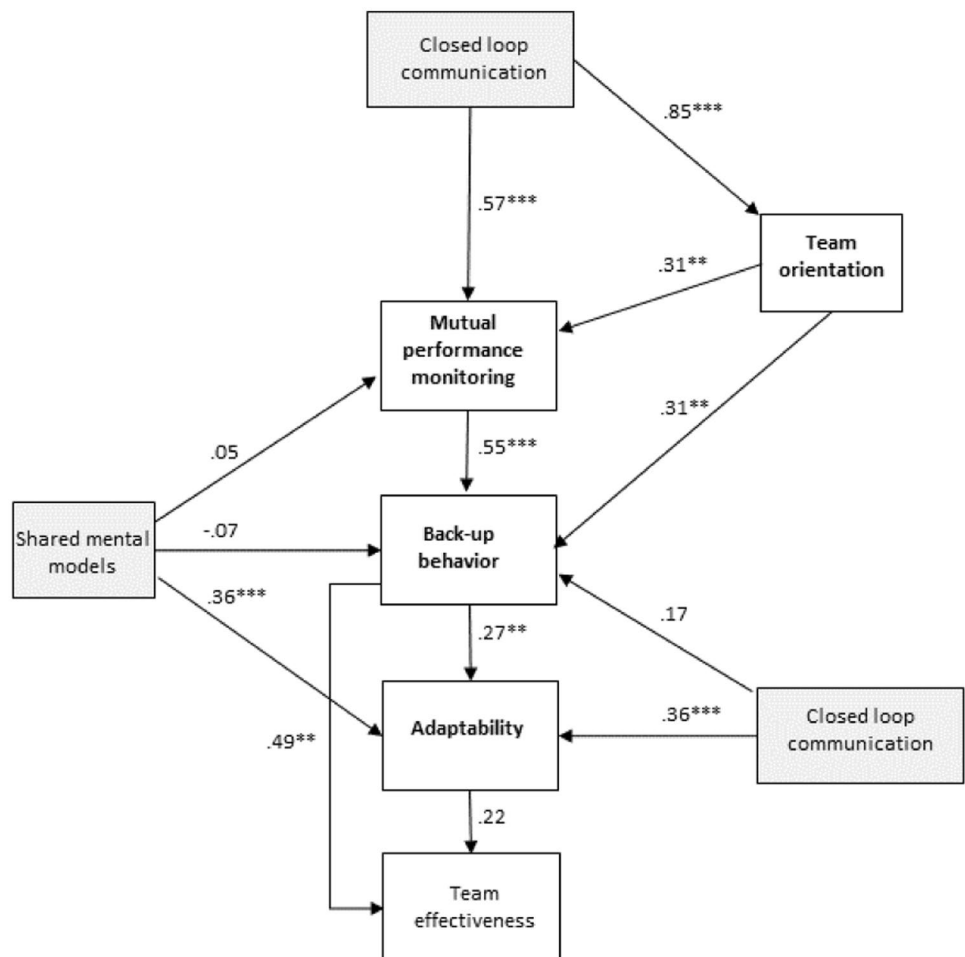
Hypotheses 3a and 3b proposed that team orientation affects both mutual performance monitoring and back-up behavior. These hypotheses were both supported, as there were statistically significant paths from team orientation to both mutual performance monitoring ($\beta = 0.31$, $p < 0.01$) and back-up behavior ($\beta = 0.31$, $p < 0.01$). Finally, the last hypothesis pertaining to a direct effect was also supported (H5): mutual performance monitoring had a statistically significant effect on back-up behavior ($\beta = 0.55$, $p < 0.001$).

Indirect Effects

The results from the tests of the indirect effects are summarized in Table 1. There are several ways to compute bootstrap confidence intervals, such as bias corrected bootstrap intervals and percentile bootstrap intervals. Hayes and Scharkow (2013) have recommended using the former, if statistical power is the major concern, but the latter if type 1 error rate is the major concern. In our analyses, the two confidence intervals yielded near identical results and we have elected to only present the percentile bootstrap confidence interval.

The indirect effects related to Hypotheses 7a and 7b were not tested, since leadership had a zero relationship with both back-up behavior and performance monitoring. Hypothesis 8 was fully supported, since performance monitoring had an indirect effect on both team effectiveness (H8a; $b = 1.06$, 95% bootstrap $CI = 0.25; 1.92$) and adaptability (H8b; $b = 0.15$, 95% bootstrap $CI = 0.01; 0.30$) through back-up behavior. Hypothesis 9 was also fully supported: team orientation affected team effectiveness indirectly through back-up behavior (H9b; $b = 0.66$, 95% bootstrap $CI = 0.04; 1.34$), and through the serial indirect effect flowing from performance monitoring to back-up behavior (H9a; $b = 0.37$, 95% bootstrap $CI = 0.01; 0.82$). Finally, the indirect effect of back-up behavior on team effectiveness through adaptability (H10) was not supported ($b = 0.21$, 95% bootstrap $CI = -0.14; 0.75$).

Discussion

The aim of the study was to explore the research propositions suggested in the model proposed by Salas et al. (2005). A reduced model showed the best fit when compared to the data.

The reduced model included the coordinating mechanism of SMMs and CLC and the team processes of team orientation, monitoring, back-up behavior, and communication. When testing the total model, six out of 10 proposed direct effects and four out of seven proposed indirect effects were found.

A Reduced Model for Police Officers?

The non-significant finding of trust as a coordinating mechanism was surprising, since an abundance of research has underlined the importance of trust in teamwork (e.g., Moe et al. 2010; DeJong and Elfring 2010; Burt et al. 2009; Schaubroeck et al. 2011). As an example, Ayenew et al. (2015) reported that employees at nuclear power facilities who trusted each other engaged in more team learning and showed higher levels of both safety compliance and safety participation, compared to less trusting colleagues. The lack of effect in the present study could be due to high trust levels, with little individual variation between the participants. It could be argued along the lines of Kolditz (2007) and others that the concept of a profession entails high levels of trust. Accordingly, the role acceptance as police officers with equivalent education, standards, code of conduct, expertise, responsibility, and collectiveness results in a high level of trust between police officers. This is in line with McComb et al. (2017), who reported high levels of trust within both a group of nurses and a group of physicians. However, the physicians' perception of trust between the two professions was lower compared to that of the nurses.

Table 1 Summary of indirect effects (Hypotheses 7–10)

Hypothesis	Independent variable	Mediator(s)	Outcome	b	95% CI	Z
7a	Team leadership	Back-up behavior	Effectiveness	□	□	□
7b	Team leadership	Performance monitoring → back-up behavior	Effectiveness	□	□	□
8a	Performance monitoring	Back-up behavior	Effectiveness	1.06**	0.35;1.77	2.94
8b	Performance monitoring	Back-up behavior	Adaptability	0.15*	0.03;0.26	2.54
9a	Team orientation	Performance monitoring → back-up behavior	Effectiveness	0.36	−0.00;0.72	1.95
9b	Team orientation	Back-up behavior	Effectiveness	0.66*	0.11;1.21	2.35
10	Back-up behavior	Team adaptability	Effectiveness	0.21	−0.11; 0.52	1.30

b unstandardized point estimate, CI confidence interval

*$p < 0.05$; **$p < 0.01$

The lack of observed effect involving team leadership behavior should be interpreted with some caution. One reason could be related to the use of dyads in the present study. Teams consisting of only two members could be relatively easy to lead, resulting in less variation in leadership scores. Another reason could be that most of the organization and planning were conducted in the driving-to-the-scene phase. This phase was not observed by the subject matter experts (SMEs) for practical reasons. Thus, the lack of effect involving leadership behavior could be due to the scenario used.

Another explanation may be the team structure in the present study. In a study by Lafond et al. (2011), team structure was investigated by separating the roles into functional versus multifunctional team structures. Functional team structures were characterized by members expressing one specific role and responsibility, while in the multifunctional structures, participants expressed several roles and responsibilities in the team. The results from their study showed that functional groups were more efficient during predictable situations, while multifunctional groups showed superior performance during unpredictable tasks and environment. Lafond et al. (2011) argued that better performance of functional groups in clear and predictable situations was mainly due to these tasks being governed by known procedures to a high degree. Since the arrest of suspected criminals is guided by legal aspects, as well as trained behavioral procedures, we would argue that this line of reasoning also applies in our study. LePine (2008) stated in his meta-analysis of teamwork that the relationship between team processes and team effectiveness was stronger in larger teams. The present study used the standard set-up for Norwegian police patrols, which is only two persons. The small group size could therefore cause a lack of effect of coordination, which in the present study was included in the leadership variable.

Taken together, high levels and little variance in scores for trust and team leadership in this study may be due to team structure (i.e., established roles and procedures), dyads, and having all participants within one profession (i.e., police officers). By reducing the model using a series of path analyses, a final model emerged, containing the coordinating mechanisms of CLC and SMMs. The effects of these mechanisms flow through the remaining four teamwork components, team orientation, mutual performance monitoring, and further onto back-up behaviors and team adaptability, and onto team effectiveness.

Most research so far has focused on single or dual variables when reporting effects of the SMM approach (e.g., monitoring: Albon and Jewels 2014; backup: Fincannon et al. 2008; adaptability: Uitewellingen et al. 2018). Since the "Big Five" model was proposed as early as 2005, an obvious need has emerged to empirically test the total model, including coordinating mechanism, and the "Big Five" team processes. To our knowledge, there is only one qualitative study of nurses (Kalish et al. 2009) that has investigated the effect of all five processes and the underlying coordinating mechanisms within the same study. The present study differs from Kalish et al. (2009) not only in terms of the quantitative approach but also by studying the police officers in a dyadic set-up. The consequence could be that team leadership is less salient and that trust is inherent in the dyad, thereby favoring a reduced model.

The reduced model's fit index indicates some support for the suggested pathways flowing from the coordinating mechanisms of SMMs and CLC, through team processes of team orientation, monitoring, back-up behavior, and adaptability, to team performance. This was also in line with studies investigating parts of the model (Westli et al. 2010; Johnsen et al. 2016; Schmidt et al. 2014; Smith-Jentsch et al. (2009). Although some of the correlations between the elements did not reach a significant level, two of the indexes showed an acceptable fit of the theoretical model when compared to the recorded data.

Coordinating Mechanisms

Shared Mental Models

The reduced model revealed a causal path from SMMs to adaptability. Teams characterized by SMMs tend to detect problems quickly, which affords them more time to respond effectively (Uitdewilligen et al. 2018) and to interpret changes in the task environment in a compatible way (Cannon-Bowers et al. 1993). This enables them to quickly change their strategy in order to adapt to the changing environment (DeChurch and Mesmer-Magnus 2010). How SMMs relate to adaptability could be understood as behavioral and directly caused by sufficient SMMs. When a team keep each other updated on the situation and coordinate their activity in order to meet altered internal and external needs, it is more likely that they will also be evaluated as more adaptive to change (Uitdewilligen et al. 2018).

The present study contradicts the findings of Fincannon et al. (2008), where dyads with a shared spatial orientation also showed a high amount of back-up behavior, resulting in low levels of workload. The study used a simulation whereby dyads (i.e., navigator and spotter) operated an unmanned vehicle. When testing the direct effect of SMMs on monitoring, no relationship was found. This could be linked to the significance of the team being a dyad that operates in a confined space. Small teams coordinating gross motor activity in proximity with each other, combined with the use of well-trained procedures, could result in SMMs masking the monitoring behavior for the observers. For instance, teams with high SMMs tend to detect and correct problems more quickly than others (Uitdewilligen et al. 2018). The detection is based on monitoring and by how SMMs could

be camouflaging observations of monitoring. However, an obvious alternative is that there is no link between SMMs and mutual monitoring, which contradicts the proposal by Salas et al. (2005).

Closed Loop Communication

Communication is increasingly important as the complexity of the environment increases (e.g., arrest of an armed perpetrator while keeping control of civilians). Communication distributes vital information to other team members and facilitates the continuous updating of the team's SMMs (Salas et al. 1997). Although included in the reduced model, Salas et al. (2005) did not generate any hypothesis regarding this mechanism. Consequently, the specific role of CLC was not tested in the present study.

Team Processes — the Big Four in Teamwork

Back-Up Behavior In the present study, back-up behavior had a direct effect on both adaptability (H2a) and effectiveness (H2b), but not on the proposed indirect effect of effectiveness through adaptability (H10). The findings of relationships between back-up behavior and both adaptability and team effectiveness have ample support in the literature (e.g., Coman et al. 2014; Schmidt et al. 2014; Finncannon et al. 2008).

Team Orientation Salas et al. (2005) have team orientation as an essential aspect of the "Big Five" theory. This study confirms this claim by showing direct effects on both mutual performance monitoring (H3a) and backup behavior (H3b). The study found both proposed indirect connections between team orientation and effectiveness to be supported. One path flowed through back-up behavior (H9b) and a second path emerged as a serial indirect effect flowing from team orientation through performance monitoring and back-up behavior (H9a). All tested effects involving team orientation emerged as significant and give evidence that team orientation holds its position in the"Big Five" model.

Mutual Performance Monitoring Logically, all team processes are dependent on the perception of team members' behavior. Monitoring is thus a central process in the total model. The predictive power of monitoring was supported by our findings of a direct effect on back-up behavior (H5). Back-up behavior reflects mutual supportive behavior without any expressed need. In order to perform supportive tasks, operators must perceive and predict needs and the possible status of the situation. The finding is in line with Porter et al. (2010). Furthermore, Lafond et al. (2011) reported that the most important predictors of effectiveness were monitoring and coordination effectiveness.

The indirect effect flowing from monitoring through back-up behavior to adaptability (H8b) emerged as significant. This confirms the propositions made by Salas (2005) and gives empirical support for the associations between different team processes encompassed in the model. This study expands the perspectives from Porter et al. (2010) and Albon and Jewles (2014) of the relation between monitoring and performance. The present study reveals how monitoring exerts its effect on performance (i.e., through back-up behavior).

Adaptability Adaptability is proposed as a team process that moves the team more effectively toward its objectives (Salas et al. 2005, ref. in Salas et al. 2005). Hence, adaptability is defined as the ability to recognize deviations from expected actions and readjust actions accordingly (Priest et al. 2002). Surprisingly, there was no statistically significant direct effect of adaptability on effectiveness (H6). However, the observed effect of $\beta = 0.22$ suggests that there is some relation between adaptability and effectiveness, and the lack of a statistically significant effect is most likely due to lack of statistical power.

Big Five Theory

A meta-analysis of 1390 teams from 31 different studies showed that teams who engage in teamwork processes are 2.8 times more likely to achieve high performance than teams who do not (Schmutz et al. 2019). Thus, what teamwork entails is an important question to approach, to secure the best team effectiveness. Salas stated already in 2008 that there was a need for studies of teamwork "in the wild." This study of frontline police officers has the potential to guide the type and focus of which kind of training is needed. The present study showed that the majority of the proposed connections made by Salas et al. (2005) were in accordance with the "Big Five" model. Hence, this study also shows that the effective performance of police officers working in dyads depends on whether they carry out "Big Five" teamwork behaviors and coordinating mechanisms. This could be generalized for other dyads that have to deal with uncertainty in high-stress situations (e.g., military personnel, firefighters, or health workers in an ongoing emergency).

Yet we should bear in mind that every team is uniquely composed to serve a specific purpose (Ervin et al. 2018). Policing shares similarities with other teamwork in other domains but is also distinctly different from other teams. "Big Five" behavior in one domain thus does not necessarily translate into high performance in another. Additionally, there are countless factors that affect the make-up of a team and subsequently influence the team's interactions. Hence, the "Big Five" theory must be investigated within teams that

comprise more than two persons (dyads), and for different domains, degrees of interdependence and structures, and across professions and tasks.

Limitations

Some caution should be observed, since there is no measurement of variability between the raters, which results in a lack of reliability testing of the rating system. The procedure whereby two experienced police officers were to agree on the score was intended to increase the possibility of differentiating between the concepts and to make the score more reliable and valid. Also, neither during the execution of the testing nor in the "hotwash" with the SME and the role players after the testing did the variation in scores emerge as a problematic issue.

Multiple-item scales are favored to measure psychological constructs (Nunnaly 1967), and this study relies on single-item measures. However, Wanous and Reichers (1996) and others support the use of single items. This is founded on empirical data showing high test–retest reliability (Littman et al. 2006), as well as high correlations with multiple-item scales (Wanous et al. 1997). The validity is also revealed by single-item measures effectively predicting outcomes (Nagy 2002). Although there are limitations, potential advantages should be noted for the use of single items. These include cost-efficiency, greater face validity, and a possible increased willingness of respondents to take time to complete the questionnaire instigated by a less intrusive method, compared to the use of multi-item scales.

Another limitation was the lack of observations during the driving or planning phase. However, the use of SME as raters made it possible to take some of the consequences of planning into consideration, such as (for example) their performance relative to their chosen equipment.

Conclusion

The present study differs from other studies focusing on elements of the models and their predictive value on performance. The target of our study was the prediction outlined by Salas et al. (2005). Although the model was generally supported, some conflicting findings were revealed. This is not surprising, since the "Big Five" theory aims to explain very complex pathways and connections, which again are dependent on each other. Dyads of frontline police officers involved in arresting a threatening perpetrator, who coordinate through CLC and have established SMMs, uphold the necessary teamwork behavior. Furthermore, the core of the "Big Five" seems to be team orientation, mutual performance monitoring, back-up behavior, and adaptation. These team processes are directly or indirectly related and may

guide future team training of police officers. Trust and team leadership were excluded in the reduced model. Logically, these elements are important in critical operations and the lack of effects could be due to the size of the team and the type of operation performed. Thus, one should be careful to conclude that they generally do not play a role in the "Big Five" theory.

Our study expands former knowledge of the "Big Five" theory by empirically identifying several important pathways. To our knowledge, this is the first study that seeks to embrace the totality of the model and show how the different parts relate to each other in a way that no previous study has done.

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