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Emergency at 35’000 Ft.: How Cockpit and Cabin Crews Lead Each Other to Safety

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Many aircraft accidents have illustrated the catastrophic consequences of ineffective leadership. However, the optimal form of leadership during emergencies on board is not yet fully explored, particularly not with regards to its influence on decision making. Several authors have studied decision making errors in the cockpit, but to our knowledge so far, nobody has considered the role of the cabin crew, who in these stressful and challenging circumstances have to closely collaborate with pilots despite obvious differences in their training and culture. This study investigates the influence of collective leadership on the quality of decision making by observing 84 cockpit and cabin crews (N=504) live during a simulated emergency. Results indicate that collective leadership strongly correlates with the quality of the decision and crew performance. To conclude, we discuss the implications of those results for decision making in aviation and recommend changes in the design and content of CRM training.

Introduction

The importance of leadership in effective teamwork is acknowledged without controversy (see Yukl, 2006 for an overview) and leadership is even more relevant where evidently it matters most: in the face of life-threatening hazards and stressful situations as encountered during an emergency on board an aircraft (Baran & Scott, 2010; Yammarino, Mumford, Connelly, & Dionne, 2010).

Recent studies have shown that collective leadership, defined as an ongoing reciprocal interactions process among all team members regardless of their formal organisational rank or authority has positive effects on team performance. Baran & Scott (2010) for instance, have concluded from their observations of fire fighting teams, that collective leadership was most effective in dynamic, stressful and dangerous situations because one single hierarchical leader could not attend to all the required leadership tasks by him- or herself at once. Similar conclusions were found in medical action and anaesthesia teams where both formally assigned leaders and informal leaders fulfilled leadership tasks and thereby increased team performance (e.g. Klein, Ziegert, Knight, & Xiao, 2006; Künzle, Zala-Mezö, Wacker, Kolbe, & Grote, 2009; Xiao, Seagull, Mackenzie, & Klein, 2004; Yun, Faraj, & Henry, 2005).

Decision making is described as one of the most important leadership tasks and decision quality is often used as a direct outcome measure of the leadership process (Vroom & Jago, 1974; Yukl, 2006).

In the past two decades, we have learnt much about decision making under stress and the potential for human error (e.g. Klein, Orasanu, Calderwood, & Zsambok, 1993; Klein, 1993, 1997; Flin, Salas, Strub & Martin, 1997). Studies in the domain of aviation have revealed interesting results with regards to traps for errors in decision making particularly in emergency situations where pilots have to make vital decisions which determine the fate of everybody on board (e.g. Orasanu, Dismukes, & Fischer, 1993; Orasanu, 1994; Orasanu & Serfaty, 1996; Orasanu & Fischer, 1997; Orasanu & Lynne, 1998).

In this paper we will investigate decision making during a simulated emergency on board and the way in which leadership influences the quality of the decision as well as the overall crew performance.

Based on what we know about the positive effects of collective leadership described above, we recorded leadership behaviour in both formal leaders, i.e. captains and informal leaders, i.e. cabin crew members.

To our knowledge cabin crew members have not yet been included in studies on decision making or leadership despite the fact that they play a crucial role in an emergency and have to closely collaborate with pilots taking part in the decision making process. Several aircraft accidents have tragically illustrated what can go wrong when this collaboration fails. For instance in 1983, 23 people on board Air Canada flight 797 were killed after smoke and fire in the cabin became uncontrollable after a tardy and ineffective decision making process involving both pilots and cabin crew members. Due to incomplete information and misunderstandings, pilots had underestimated the risk posed by the smoke in the cabin whereupon they delayed the decision and lost vital time. Had the captain or in fact any other crew member on this eventful flight fulfilled some of the most basic leadership tasks such as maintaining an overview of the situation, supervising or correcting the actions of the other crew members, the decision effectiveness and hence the overall outcome could have been very different (TSBC, 1983).

For this study we have created a similar scenario in which cockpit and cabin crews, due to differing information and closed cockpit door, had to all contribute in order to reach the correct decision (Vroom & Jago, 1974). In that way we were able to observe 504 cockpit and cabin crew members live in a simulator with regards to their leadership behaviour, whereby we followed the functional team leadership theory (Zaccaro, Rittman, & Marks 2001) and classified leadership according to Yukl's leadership taxonomy (2006).

Hypotheses

We derive our assumption from the theory described above and postulate the following hypotheses:

H1: In crews with correct decision making, the overall crew performance is significantly higher than in crews with faulty decision making.

H2: In crews with correct decision making, the overall amount of leadership is significantly higher than in crews with faulty decision making.

H3: Only in crews with correct decision making does collective leadership, i.e. leadership demonstrated by formal leaders (captains = CMDs) as well as leadership shown by informal leaders (cabin crew members = CCMs) significantly predict crew performance.

Methods

Participants

A total of 504 cockpit and cabin crew members (84 crews) of a medium sized European airline voluntarily participated in this study, whereby participants had been chosen randomly depending on their flight schedule.

Flight experience of captains varied from nine to 37 years (M = 26.18, SD = 5.19) and from one year to a maximum of 31 years for first officers (M = 13.08, SD = 6.68). Cabin crew members had between 11 months and 37 years (M = 19.44, SD = 7.99) of professional experience. The age of the participants followed a normal distribution with an average of 50 years for captains, 39 years for first officers and 36 years for cabin crew members. There was a significant sub-group specific gender bias (cockpit crew 100% male and cabin crew predominantly female with 79% against 21% male). Anonymity of all participants was guaranteed.

Procedure

The observations took place during a simulated emergency exercise in the A320 cabin flight simulator which was part of the annual safety training day at the respective airline.

Each crew performed a standardized flight during which they had to deal with an onboard emergency of a critical nature while three trained observers recorded frequencies of various leadership behaviours as described below.

Directly after completion of the simulated flight two independent subject matter experts and safety instructors completed a team performance evaluation form and subjects were asked to fill in a questionnaire to collect team process variables, control variables and biographical information.

Following this all participants received a training oriented debriefing.

Apparatus

The Airbus A320 cabin flight simulator is a special form of high fidelity simulator equipped with a two-man cockpit and a fully furnished passenger cabin seating up to 20 passengers, thus creating a realistic environment for cross-disciplinary mixed team training.

Using hydraulic mechanisms various airplane movements can be simulated and the training of emergency situations is enabled through different manipulations such as system malfunctions, alarms, smoke etc.

To further increase face validity the cabin flight simulator is equipped with the original intercommunication system, cabin signs and emergency equipment. Realistic audio simulation and background noises facilitate further immersion into the experience.

Scenario

For the purpose of this study a specific 20 minutes long standardized scenario was created in which pilots, due to physical separation (closed cockpit door), had to base their decision making on the information they received from the cabin crew. The situation began with a normal course of flight which then developed into a critical emergency situation. While pilots had no indication of a problem in the cockpit throughout the entire exercise, smoke started to develop in the cabin, gradually intensifying. The scenario was developed by the first author together with two subject matter experts and validated by one training captain and seven safety instructors.

Face validity of the scenario was rated as high by 86% of all participants, indicating that they felt the scenario was realistic, that they acted accordingly and that they believed that a real crew would act in the same way.

Leadership

Leadership behaviour was coded by means of a leadership taxonomy based on Yukl's categorical system of 14 managerial position duties and responsibilities (Yukl, 2006) and recorded by means of event sampling in real time, using TrackVivo ©, a data sampling software (SmarTrack, 2009).

Observers and interrater agreement. The first author and three undergraduate psychology majors with current or past background as cockpit or cabin crew served as on-site observers.

To check the accuracy of coding 10% of data (10 crews) were recorded on video and double coded. Cohen's kappa for the different leadership codes ranged from $\kappa = .82$ (consulting others) to $\kappa = 1.0$ (delegate sth. to sb.), indicating excellent interrater reliability.

Performance measure

Performance was assessed by two trained safety instructors and subject matter experts.

For this purpose, a checklist based and time sensitive and weighted performance rating system was developed and validated using Delphi Technique (Clayton, 1997) this rating system was validated by 5 safety experts (experience > 10 years) over the course of three discussion rounds.

Decision making

The correctness of the decision was assessed by a safety instructor and subject matter expert and consisted of one dichotomous variable (Did the pilots reach the correct decision within the predefined time frame? Yes or No). If the correct decision was reached but the critical point in time had passed, the decision was rated as wrong because according to the given scenario, a successful landing would not have been possible anymore.

Orasanu & Lynne (1998) point out that in real life scenarios, there is often no clear standard of "correctness" and that the "best" decision may not be well defined. This is why we chose a scenario which was very simple in this respect. If the information (location, colour, density, development, smell of smoke) was correctly passed on to the pilots, the correct decision could be reached by means of recognition-primed-decision making (RPDM) (Klein, 1993). All subsequent actions were fully under control of the pilots and could be carried out in accordance with the corresponding emergency procedures. If the information received from the cabin was incomplete however, there was significant potential for misunderstanding.

Results

First the data was tested for potential influencing factors such as job experience, experience in a formal leadership position, age and gender. None of them showed significant effects on the statistical models.

All data collected from first officers was excluded from the analyses because interactions between cockpit and cabin crews took place between captains and cabin crew members exclusively.

To compare the leadership and overall performance in crews whose decision making was correct (N=63) with the performance in crews whose decision making was faulty (N=21), we computed two independent *t*-tests which revealed the following results:

On average, the overall performance in crews with correct decision making was higher ($M = 4.68$, $SE = .14$) than in crews with faulty decision making ($M = 3.71$, $SE = .37$). This difference was significant $t(82) = 2.88$, $p < .01$.

With regards to leadership we also found significant differences between the groups ($t(82) = 2.14$, $p = .03$) whereby crews who reached the correct decision demonstrated more leadership in total ($M = 5.86$, $SE = .53$) than crews who made a faulty decision ($M = 4.60$, $SE = .28$).

For the purpose of identifying the influence of leadership on performance in dependency of the quality of decision making, we split the data by the variable 'decision making' (correct vs. faulty) and computed a hierarchical regression model. As demonstrated in table 1, leadership of captains, entered as a first factor, was a significant predictor for performance in crews who made the correct decision ($B = -1.78$; $SEB = .92$, $\beta = -.22$, $p = .043$) but not in crews with faulty decision making ($B = -2.13$; $SEB = 2.29$, $\beta = -.29$, ns.). Similarly, leadership demonstrated by cabin crew members, entered as a second factor, significantly predicted performance ($B = 4.34$; $SEB = 1.62$, $\beta = .29$, $p = .009$), but again only in crews who reached the correct decision. However, this significant second factor effect reduced the influence of captains' leadership, making it statistically insignificant ($B = -1.55$; $SEB = 0.88$, $\beta = -.19$, $p = .08$). Contrary to our expectation, the interaction effects between predictors one and two were statistically insignificant.

Table 1.

Hierarchical regression model for the effect of leadership on crew performance in dependency of the quality of decision making (decision correct vs. decision wrong)

Decision correct
Crew performance

predictors	*B*	*SEB*	β	t	Sig.
Step 1					
(Constant)	21.11	5.12		4.12	.000
Leadership CMD	-1.78	0.92	-.22	-1.93	.043*
Step 2					
(Constant)	-2.44	10.09		-0.24	.810
Leadership CMD	-1.55	0.89	-.19	-1.75	.084
Leadership CCM	4.34	1.62	.29	2.67	.009**
(Constant)	-3.62	18.06		-0.20	.842
Leadership CMD	-1.33	3.00	-.16	-0.44	.659
Leadership CCM	4.58	3.52	.31	1.30	.196
LS CMD * LS CCM	-0.05	0.60	-.03	-.08	.937
N					84

Decision incorrect
Crew performance

predictors	*B*	*SEB*	β	t	Sig.
step 1					
(Constant)	11.17	14.23		0.78	.453
Leadership CMD	-2.13	2.30	-.30	-0.93	.376
step 2					
(Constant)	-12.34	16.04		-0.77	.464
Leadership CMD	-3.32	1.99	-.46	-1.66	.135
Leadership CCM	6.55	2.99	.61	2.19	.060
(Constant)	13.51	37.48		0.36	.729
Leadership CMD	-7.97	6.40	-1.11	-1.25	.253
Leadership CCM	.50	8.46	.05	0.06	.955
LS CMD*LS CCM	1.05	1.37	.99	0.77	.468
N					84

Note: CMD = Commander, CCM = Cabin Crew Member

Discussion

This study offers some new evidence to strengthen the notion that leadership plays a crucial role in the decision making process (Vroom & Jago, 1974; Yukl, 2006). Our results demonstrate that significantly more leadership was displayed during the decision making process in crews who reached the correct decision. Furthermore, leadership was a significant predictor for crew performance, but only in crews who had reached the appropriate decision. This effect was insignificant in crews with erroneous decision making.

The more interesting result however is that not only formal leadership (demonstrated by captains) correlated strongly with performance in crews with good decision making, but informal leadership (demonstrated by cabin crew members) correlated even more strongly with crew performance.

These findings contribute to the ongoing research on the effectiveness of collective leadership and go in line with what others (e.g. Baran & Scott, 2010; Klein et al., 2006; Künzle et al., Xiao et al., 2004) have observed in similarly structured teams, implicating a change in the traditional leadership paradigm where leadership is seen as centralized within one single hierarchical leader (see Yukl, 2006 for an overview).

The call for proactive participation and support in the leadership process by informal leaders however will not be adequately answered if crew members lack the necessary knowledge, skills and attitudes. Should the active participation of so called ‘followers’ in the decision making and leadership process continue to demonstrate positive effects on performance, the implications for training would be great in that every crew member would have to be trained to effectively execute some of the necessary leadership tasks. Before that is the case though, more research on the subject is needed and potential negative effects (e.g. competing leaders creating chaos and diffusion of responsibility) need to be considered.

What we suggest instead is that cockpit and cabin crews should each act as a system of redundancy within and between themselves in correspondence with the credo of ‘Crew Resource Management’ (CRM) in that all available resources of the crew should be used for the purpose of a safe and efficient flight operation (e.g. Helmreich, et al., 1999).

Specifically we propose that the importance of leadership and decision making be addressed in CRM-training involving both cockpit and cabin crews. All crew members should be given the opportunity to train the skills and behaviours that are needed for effective interdisciplinary collaboration in an emergency by having to interact with each other during task-oriented, practical training sessions using realistic scenarios.

Limitations

The sample was drawn from only one airline and in only one industry. Although this controls for the influence of contextual issues, it raises the issue that the results may not generalize to other organizational contexts. Given the structural similarity of teams working in other high risk environments such as medicine, policing or fire fighting, we would argue however, that these findings are transferable and may have important implications also for their training.

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