Multidisciplinary Cooperation in Crisis Management Teams: a Tool to Improve Team Situation Awareness

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ABSTRACT

When a crisis occurs, people from different organizations, on different hierarchical levels have to deal with unexpected situations that require coordinated effort. The goal of this research is to improve multidisciplinary cooperation for crisis management teams. We developed a tool, the Multi-mono guide, which helps team members to share information at the right time, with the right person, in the right way. A pre-test post-test intervention experiment was conducted with 8 professional teams to evaluate the effect of the tool on individual competencies, team situation awareness and process satisfaction. The experimental group was more satisfied with the meetings and about the way they shared information. Participants reported that the Multi-mono guide makes them aware of sharing information. We didn't find significant differences for individual competencies and team situation awareness. This is may be because the teams that participated were very experienced. Participants did find the Multi-mono guide useful for trainees.

Keywords

Team situation awareness, crisis management teams, multidisciplinary teams, cooperation, Network Centric Organization, competencies

INTRODUCTION

Nowadays, organizations are operating in a turbulent and ever changing environment, which requires quick and adaptive responses of organizations. This holds for commercial companies, to react to market demands (Brown & Eisenhardt, 1998) as well as crisis management organizations, to respond quickly and effectively to unexpected calamities (Quarantelli, 1988). In recent years, new organizational structures have been adopted to react quickly to the changing environment. Decentralized, team based, and distributed structures enable organizations to achieve a quick response (DeSanctis & Jackson, 1994; Drucker, 1988; Lipnack & Stamps, 2000; Martins, Gilson, & Maynard, 2004; Priest, Stagl, Klein, & Salas, 2006). The organizational structure of crisis management organizations is also changing; from a hierarchical organization to a more netcentric organization, a so-called Network Centric Organization (NCO), a development which will be described in this paper. When there is a crisis or calamity, people from different organizations, on different hierarchical levels have to work together. Units are assembled from, for example, the police force, the fire departments, and the paramedics, to deal with unexpected situations that require coordinated effort for a limited time span. Currently, the Dutch crisis management organization consists of four different levels: the policy, operational, tactical, and field levels (van Rijk, Post, & Verseveld, 2001). Sharing information among these different levels takes time. In a hierarchical structure, by the time information has reached its destination, information is often outdated. In an NCO, information can be easily shared between people from different organizations, horizontally and vertically

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(Alberts, 2007). This will extend the communication network as information will be shared at more levels between the disciplines, resulting in a better and faster view and understanding of the crisis at all levels by all disciplines. An important step for an organization to become an NCO, is improving collaboration in a multidisciplinary team. Collaborative working in multidisciplinary teams often leads to good solutions, as the problem is seen from different perspectives by the different disciplines (Jackson, 1996).

However, information sharing between the different disciplines is often a problem (Van Santen, Jonker, & Wijngaards, 2009). This was illustrated in a large-scale multidisciplinary exercise held on 3 October 2007 in the Netherlands (Capgemini, 2008). Shared situation awareness was lacking across the various chains and the different organizational levels during the exercise. This was mainly due to insufficient and untimely sharing of information, probably caused by difference in expertise and organizational background. For effective sharing of information team situation awareness is necessary. Team Situation Awareness (TSA) is important for effective decision making and team results. Without TSA, teams lack common ground on which to base their decisions, and the result may be flawed decision making due to different perceptions of the situation, the current task, the responsibilities involved, or other factors. TSA is often a problem because team members do not always understand which information is needed by other team members, because they lack the proper devices to share information, because they lack shared mental models, or because they lack the communication skills for sharing relevant information (Schraagen, de Koning, Hof, van Dongen, 2010). Building and maintaining TSA in a multidisciplinary team is even more complex. In addition, team members need specific competencies to operate in a NCO team. Competencies are indivisible clusters of skills, knowledge, conduct, attributes and notions. They are context dependent, connected to activities and tasks, flexible in time, acquired by learning and development and related to each other (van Merriënboer, van der Klink, & Hendriks, 2002). As such, competencies may help organizations to fit education and development of their personnel to the organization needs (Garavan & McGuire, 2001), in this situation operating in NCO teams. In a previous study, a questionnaire was developed to measure the competencies needed for operating in networks (Theunissen & van Rijk, 2009). Summarizing, to be able to effectively and efficiently share information, changes are required at the organizational level (NCO), team level (TSA), and individual level (NCO competencies for team members).

To improve multidisciplinary collaboration, a tool was developed which supports team members in sharing information at the right time, with the right person, in the right way: the Multi-mono guide. For development of the tool we worked in close cooperation with a Dutch safety region. A safety region is a part of the Netherlands where there is a collaboration between different crisis management organizations (the fire department, police force and medics) and the municipalities. We focused on horizontal cooperation in a multidisciplinary team: a Command Place of Incident team (CoPI team). The CoPI team coordinates all tasks carried out at the incident location. A CoPI team consists of different team members: a representative of the police force, the fire department, the paramedics service, a team member who draws the situation on a map, an information manager, and a team leader. Depending on the type of the crisis, representatives from other organizations may participate. This team has several short meetings near the location of the calamity in a container equipped as a meeting room. An important goal of these meetings is multidisciplinary coordination and decision making. Between these meetings, each team member shares relevant information and actions from this meeting with his or her own (monodisciplinary) team members. Also new information is collected from the own discipline at the location of the calamity. At a predetermined time, the CoPI meeting will be resumed. This 'battle rhythm' continues until the incident is resolved. During different crisis management exercises in a Dutch safety region, it was observed that often information was kept within the own discipline for too long a time, before the information was shared with other disciplines. For example, team members waited until their next (resumed) meeting to share information with other disciplines or took too much time for sharing irrelevant information during meetings. The aim of the Multi-mono guide is to support multidisciplinary collaboration in a crisis management team.

The objective of the current study is to investigate the usability and usefulness of the Multi-mono guide, its effect on team situation awareness, process satisfaction and NCO competencies. In this paper, we will first describe the the Multi-mono guide and its development. Next, the research methods and results of the effect study of the Multi-mono guide are described.

DEVELOPMENT OF THE MULTI-MONO GUIDE

The Multi-mono guide has several sub-goals. First, it makes CoPI team members aware of who needs what information. Some information is only relevant for the own discipline, while other information is also important for another discipline or even all disciplines. For instance, information about a road block around the location of the calamity is important for the police (in order to control the traffic), but also for the medical aid team to drive towards the calamity with ambulances and casualties. Secondly, each CoPI team member should become aware

of how quickly information should be shared with other disciplines. Is it possible to wait until the next multidisciplinary meeting or should information be shared directly, for example by calling the meeting earlier? Thirdly, CoPI team members should become aware of the way the information should be shared. Is it necessary to share the information during the (next) meeting or is it enough to have a bilateral chat with one of the other disciplines? The Multi-mono guide itself is a small card where the considerations that experts make, are arranged as questions. If the answer to one of these questions is yes, information should be shared. Depending on the urgency of the information and the relevancy for each team member, additionally the decision should be made at what time this information should be shared (now, or during the following meeting) and how (physically in an ad hoc CoPI meeting, or use a portable radio). These two questions are also added to the card.

The content of the Multi-mono guide was developed by questioning 5 experienced CoPI team members about how they determine whether information should be shared, what considerations they make, and what kind of information they expect to receive from team members. Apart from that, we also asked them to give examples of information sharing during a crisis. In developing the Multi-mono guide, knowledge about whether information should be shared with other team members is made explicit. From these interviews we concluded that the following questions are important in determining whether information should be shared:

1. Information that influences the safety of team members. For example, a threat of an explosion, but also when the threat of an explosion is over.
2. Information that influences the safety of victims or citizens. For example, when toxic gases are measured at the incident place and are a threat for the citizens in the neighborhood.
3. Information that changes the picture of the situation in such a way that different actions are needed. For example, information about the cause of an explosion (a gas leak) when a terroristic attack was assumed.
4. Bottlenecks that have an effect on one of the other disciplines. For example, when there are not enough ambulances to transport the victims to hospitals.
5. Information that influences the tasks of other team members. For example, when the number of missing children is 2 instead of 5 during a forest fire.

To train people with the Multi-mono guide, an e-learning tool was developed. This e-learning tool consisted of different parts: explanation about strengths and weaknesses of multidisciplinary teams, explanation of the multi-mono guide with examples of different situations, and finally an exercise with the multi-mono guide. This exercise consists of different incident scenario's. A decision has to be made whether different information elements should be shared, how and when.

To summarize, the Multi-mono guide supports the participants in their choices of sharing information mono- or multidisciplinary, and whether information should be shared immediately or if it can wait until the next meeting. It is expected that by using the Multi-mono guide, the information is more effectively shared. This will result in a better and more accurate vision of the current situation of the calamity. An increase of team situation awareness is expected. This will support the decision making in order to control the calamity. As the e-learning tool trains the participants in applying the Multi-mono guide, we expect that the competencies regarding communication and information sharing (which is what the Multi-mono guide is about) will be acted upon more by the experimental group. Also, we are interested in the effect of Multi-mono guide on the process satisfaction of the team.

RESEARCH METHOD

Experimental design

In this experiment, the usability and usefulness of the Multi-mono guide was tested as well as the effect of the Multi-mono guide on team situation awareness, process satisfaction and NCO competencies. Therefore, eight CoPI teams from 4 safety regions were assigned to either the experimental group or the control group. The experimental group used the e-learning tool to practice with the Multi-mono guide. The control group performed a multi-tasking computer task that is not expected to improve multidisciplinary cooperation. A pre-test was performed by both groups (with the last crisis training in mind) which was used as baseline (Measurement 1). The e-learning tool to practice with the Multi-mono guide, was used in the experimental group only. After the practicing with the Multi-mono guide in the e-learning tool, the experimental group rated the usability and usefulness of the Multi-mono guide (Measurement A). The second measurement of the competencies, team situation awareness and process satisfaction took place after the scenario (Measurement 2). The experimental design is shown in Table 1.

	Measurement 1	Treatment	Measurement A	Task of team	Measurement 2
Experimental group	TSA Competencies Process satisfaction	Multi-mono guide by E-learning	Usability and usefulness of Multi-mono guide	Manage crisis in a scenario, support of Multi-mono guide	TSA Competencies Process satisfaction
Control group	TSA Competencies Process satisfaction	Multi-tasking task		Manage crisis in a scenario, No support of Multi-mono guide	TSA Competencies Process satisfaction

Table 1. Experimental design

Each team consisted of six persons: a team leader, a police officer, a fire department officer, a paramedic service officer, an information manager and a team member that plots graphical information of the situation. This last team member however, was not from the participating safety region. This had to do with the plotting device used in the experiment. Normally, each safety region uses their own plotting device, generating somewhat different information. This might influence the experiment. For standardizing reasons a new device was built based on generic characteristics of the most commonly used plotting devices. To make sure that the team could use the plotting device, we standardized the team member that operates the device as well, using a roll player. This person, a trainee, participated in every team. He did not take any initiative what to plot and was only supportive to the team requests.

Participants

Forty participants volunteered in this experiment. They were all professional CoPI members and came from 4 different safety regions in the Netherlands. Their age ranged from 27 to 58 years (mean 44.7, s.d. 7.7 years). The years of experience in their current discipline ranged from 3 to 35 years (mean 15.0, s.d. 10.2 years). Three of the participants were female and 37 were male. Eighty-eight percent of the participants rated in a self assessment that they had more than an average experience in their current function.

Task

The teams were instructed to act like they do in their normal crisis management training or during an actual crisis. Their task was to control the incident as described in a scenario. The scenario was about a multiple collision on a junction of two busy motorways in the centre of the Netherlands on a hot summer day in the morning. A bus with schoolchildren, several cars and a lorry transporting diesel were involved in the collision. The lorry was tilted and leaking diesel (which later on in the scenario turned out to be petrol). The chaos on the road resulted in long traffic jams on the main road and the supply lines. Roadblocks were necessary for emergency services. This scenario was written in a way that it was necessary to share information from the own discipline immediately with the other disciplines. The teams could decide themselves when they would meet and the time that meeting lasted. Moreover, they could decide to organize bilateral meetings with only one other discipline.

Measurements

General questionnaire: This questionnaire addressed personal characteristics (age, sex, discipline, function, years of experience in this discipline) and also the self-reported experience in the current function in crisis teams (1 item with a 7-point Likert scale from 1 (very inexperienced) to 7 (very experienced)).

Team situation awareness (TSA): This awareness was measured using the self-rating questionnaire developed by Schraagen et al. (2010). The questionnaire consists of five factors: Building/sharing a picture of the situation (8 items; e.g., 'Within my team we actively sought further information to extend and elaborate the picture of the situation'); Heedful interrelating (5 items; e.g., 'Within my team members we verified that information sent was interpreted as intended'); Shared situation awareness (5 items; e.g., 'Within my team had a shared awareness of the goals to be achieved'; Team factors (4 items; e.g., 'Within the team we had insight in each others information needs'); Task factors (5 items; e.g., 'The decisions taken have high quality'). The statements were

rated on a 7-point Likert scale ranging from 1 (totally disagree) to 7 (totally agree).

NCO competencies: The competencies needed for operating in a network were measured by questionnaire (Theunissen & van Rijk, 2009). This questionnaire consists of seven factors: Leadership skills (12 items; e.g. 'I take decisions, even when the picture of the situation is not complete'); Working in ad hoc teams (7 items; 'I am able to cooperate with people from other organizations'); Open mind for ICT tools (6 items; 'I use ICT systems to collect information and knowledge quickly'); Own role in behalf of the team (6 items; 'I know my role within the team'); Information processing (8 items; 'I check the reliability of the information received'); Social skills (8 items; 'I show my trust in the competencies of other team members'); and Communication skills (12 items; 'I check whether my information is clearly understood by the other team members') (Theunissen & van Rijk, 2009). The statements were rated on a 7-point Likert scale ranging from 1 (totally applicable) to 7 (totally not applicable).

Process satisfaction: Process satisfaction was measured using the process satisfaction construct evaluated by Post, Huis in 't Veld, & van den Boogaard (2008). This construct consists of four items: 'I am satisfied with the process by which the group made its decisions', 2) 'I am satisfied with the meetings', 3) 'I am satisfied with the way we shared information' and 4) 'I am satisfied with the way we generated ideas'. For each item, the participants indicated their degree of agreement on a seven point Likert scale ranging from 1 (totally disagree) to 7 (totally agree).

Usability and usefulness: The usability of the Multi-mono guide was indicated using the System Usability Scale (SUS) (Brooke, 1996). SUS is a simple, ten-item scale which gives a global view of subjective assessments of usability. The items are statements regarding the system's usability, like: 'I think that I would like to use this system frequently' and 'I thought the system was easy to use'. The participants have to indicate the degree of agreement or disagreement with the statement on a 5 point Likert scale. The usefulness was tested by a questionnaire specifically developed for this purpose, containing questions like: 'I had enough time to practice with the Multi-mono guide' and 'The e-learning tool to practice the Multi-mono guide was useful'. These items were rated on a 7-point Likert scale ranging from 1 (totally disagree) to 7 (totally agree).

Observations: During the experiment observations were made by two observers. The observers wrote down who shared what information with whom in the field, and what information was shared during the meetings. The observers knew the scenario and knew beforehand who possessed what information at what time. The experiment was single-blind. The observers knew whether the group was the experimental or the control group.

Procedures

The experiment leader started with welcoming the participants and giving information about the experiment. The participants filled out the first, general questionnaire. Additionally, they filled in the TSA, the competence questionnaire and the process satisfaction and leadership initiative questionnaires with their last crisis management training in mind. After that, the experimental group used the e-learning tool to get trained in using the Multi-mono guide. The control group carried out the non-intervening task on the computer. After 15 minutes, the computer task ended. The experimental group filled out a questionnaire to test the usability and usefulness of the Multi-mono guide (the SUS and the usefulness questionnaire). Next, the team went to the room that was assigned as the meeting room for the CoPI team, which we will refer to as 'the CoPI room'. The team member that plots information gave some instructions to the team about the plot functions, because the teams were not familiar with this plot system as all safety regions use different systems. Then, the scenario started with notification of a collision and they received the first information from the control room. In separate rooms for each discipline (fire department, police, paramedics) team members could get more information from the field of their own discipline. The experimenters gave the information from the field as written down in the scenario and answered questions of the officers. Depending on the information they received, officers could determine whether they wanted to share information before the CoPI meeting with other team members, or whether they waited until the next meeting. The team leader was free to determine when the CoPI meetings should start and end. When a meeting started, all disciplines came back to the CoPI room. At the end of the first meeting, the team leader usually set a time for the next meeting, and the officers went out to 'the field' again to receive information from their colleagues in the field (the experimenter). Then, they came back to the CoPI room for the second meeting. After the second meeting ended, the experimenter ended the scenario. The participants filled out the questionnaires for the second time.

Data analysis

For TSA and NCO competencies scale scores were obtained by adding item scores within scales, and

transforming crude scale scores linearly to a 0-100 scale, with higher scores indicating better results.

The hypothesis was that the experimental group would have increased team situation awareness, and would score higher on process satisfaction and NCO competencies in comparison with the control group. Therefore, it is expected that there will be a bigger increase between Measurement 2 (M2) and Measurement 1 (M1) on TSA, competencies and process satisfaction for the experimental group. The differences between M2 and M1 was calculated by subtracting the factor scores. A univariate ANOVA was carried out on the t difference scores of the TSA and NCO competence factors to test whether the change between M2 and M1 differed between experimental and control group. As years of experience or self-estimated experience may affect the ratings on the TSA, these variables were added as confounding factors. Additional Pearson's correlations were calculated to test for a univariate relationship between experience and TSA. For the process satisfaction an independent t-test was performed. Results of statistical analyses were reported as significant with a p-value of .05 or less.

The usability SUS score was calculated according to Brooke (1996). Each item's score contribution will range from 0 to 4. For items 1, 3, 5, 7 and 9 the score contribution is the scale position minus 1. For items 2, 4, 6, 8 and 10 the contribution is 5 minus the scale position. The sum of the scores has to be multiplied by 2.5 to obtain the overall value of SUS. SUS scores have a range of 0 to 100 (Brooke, 1996), with higher scores indicating a higher subjective assessment of the usability tool. For the usefulness questionnaire, the average rating (and standard deviation) of the separate items were calculated.

Team situation awareness

Table 2 shows the difference scores for both the experimental as the control group for the five factors of the team situation awareness questionnaire.

	Experimental group	Control group
TSA factors:	Mean difference score (s.d.)	Mean difference score (s.d.)
Building picture	7.3 (10.4)	7.4 (14.2)
Heedful interrelating	9.8 (10.5)	7.7 (13.1)
Shared situation awareness	7.7 (9.7)	9.3 (10.4)
Team factors	7.9 (12.1)	9.6 (10.3)
Task results	1.7 (11.2)	3.0 (13.2)

Table 2. Mean difference score and standard deviation (s.d.) of the TSA factors

The univariate ANOVA revealed that for none of the factors of the TSA differences between the experimental and the control group could be found for the change between M1 and M2, nor a confounding effect was found for years of experience or self-estimated experience. It may be due to the small sample size that we did not find a confounding effect. Therefore, we calculated the Pearson's correlation coefficient to see if a correlation exists between experience and ratings on the TSA for measurement 1. For the years of experience, only a significant correlation was found for the factor shared situation awareness ($r=0.293$, $p=.033$). The self-estimated experience was correlated to all factors of the TSA, with r ranging from 0.58 ($p=.00$) for shared situation awareness to $r=0.497$ ($p=.00$) for task results.

	Experimental group	Control group
Competencies:	Mean difference score (s.d.)	Mean difference score (s.d.)
Leadership skills	3.8 (6.3)	0.3 (7.1)
Working in ad hoc teams	0.5 (7.8)	-6.2 (14.6)
Information processing	1.3 (10.2)	-0.1 (7.9)
Open mind for ICT tools	3.3 (6.0)	1.1 (8.6)
Social skills	0.1 (9.2)	-2.3 (9.4)
Communication skills	1.7 (4.9)	-0.3 (8.3)

Own role subservient to the team	2.0 (12.6)	-2.2 (22.1)

Table 3. Mean difference score and standard deviation (s.d.) of the competence factors

Results

Competencies

Table 3 shows the difference scores for both the experimental and the control group for the seven factors of the competencies questionnaire. No significant differences were found for the change in competence factors between the experimental and the control group. Only for working in ad-hoc teams a tendency was seen ($F=3.249$, $p=.081$). Years of experience was a confounder for the factor social skills ($F=6.102$, $p=.019$) and it tend to be a confounder for communication skills ($F=3.973$, $p=.055$). The self-estimated experience tends to be confounding for the NCO competence factors: working in ad hoc teams ($F=3.995$, $p=.054$), communication skills ($F=3.454$, $p=.072$) and own role subservient to the team ($F=2.946$, $p=.096$).

Process satisfaction

Table 4 shows the average difference between M2 and M1 of the process satisfaction items for both the experimental and the control group. Significant differences between the experimental and the control group were found for satisfaction with the meeting ($t=2.331$, $p<.05$) and for satisfaction in the way information was shared ($t=2.081$, $p<.05$). For both items the mean difference between M2-M1 was higher for the experimental group compared to the control group.

Process satisfaction:	Experimental group	Control group
	Mean difference score (s.d.)	Mean difference score (s.d.)
Satisfied with decision making	0.30 (0.86)	0.15 (1.18)
Satisfied with meeting	0.40 (0.75)	-0.35 (1.23)*
Satisfied with information sharing	0.40 (0.75)	-0.30 (1.30)*
Satisfied with generating ideas	0.60 (0.88)	0.30 (1.56)

Table 4. Mean difference score and standard deviation (s.d.) of process satisfaction items

*Significant difference between experimental and control group

Usability and usefulness

The usability of the Multi-mono guide is expressed by the average SUS-score, which is 72.3 (s.d. 12.5) on a 0-100 scale. As the SUS-score is a standardized score, the results of the usability of the Multi-mono guide can be benchmarked with other applications. Bangor, Kortum, and Miller (2008) indicated that a SUS-score above 70 stands for a passable application (regarding usability). The results of the usefulness of the e-learning tool as well as the Multi-mono guide itself, are shown in Table 5.

Usefulness items	Mean (s.d.)
The Multi-mono guide is nice to use	5.2 (1.3)
The Multi-mono guide has good looks	5.0 (1.6)
The Multi-mono guide is user-friendly	5.2 (1.3)
The Multi-mono guide makes me aware about interdisciplinary information sharing	4.8 (1.7)
I had enough time to practice with the Multi-mono guide	5.5 (1.2)
It was clear to me how to use the Multi-mono guide	5.9 (1.1)
The e-learning tool to practice the Multi-mono guide was useful	5.0 (1.4)

Table 5. Mean and s.d. of usefulness (scale 1-7)

Observations

Observers noticed that information was not always shared at the right time, with the right persons, although they sometimes seemed to be aware of this omission. This was observed in both conditions. For example at one time the team leader pointed out to two team members that they had important information that should be shared with the other team members. The team leader referred to the Multi-mono guide. After that, the information was shared with all team members. It was also observed that in the experimental condition team members more explicitly referred to whether they should share information. For example, a team member from the medical department asked whether he should share information concerning the status of the victims. Other observations that point in this direction were: that team members explicitly mentioned that they wanted to reconcile with another discipline; and that during a meeting team members check whether they should share information directly with team members in the field. It was observed that the scenario used and the setting was not experienced as stressful to the experienced team members.

Discussion and conclusion

It was expected that the Multi-mono guide would improve team situation awareness and the NCO competencies. However, the Multi-mono guide did not affect any of these factors as the change between measurements was the same for the experimental and the control group. Only, differences were found for the separate items of process satisfaction. The experimental group (which used the Multi-mono guide) was more satisfied with the meetings and more satisfied about the way they shared information. This was in line with the expectations because the Multi-mono guide was aimed to improve information sharing. Also, observers had the impression that in the experimental condition people more explicitly mentioned whether information should be shared or not. This might explain why the experimental group is more satisfied with the meetings and the sharing of information.

There may be several explanations for the fact that we did not find the intended effect of the Multi-mono guide on TSA and NCO competencies: 1) the participants were very experienced, 2) the learning effect was not sufficient 3) the scenario might have been too easy and induced not the 'real' stress of a crisis, 4) the research method of this study. These explanations are described below.

The first reason for the absence of intervention effects may be that the participants of the experiment were very experienced. Their average experience was 15 years. 88% of the participants rated themselves to have more than average experience. Due to the small sample size, neither years of experience nor self-estimated experience was a confounding factor for the difference between experimental and control group on the TSA. However, univariate correlations were found between the TSA and years of experience and self-estimated experience. For the TSA questionnaire, team members have to judge the different items for the whole team. Participants with less (self-estimated) experience showed lower ratings on the TSA. Depending on experience, participants differently judged how the team performed. This supports our assumption that the experience of the participants could have affected the effect of the Multi-mono guide on TSA. The same pattern, although not statistical significant, was found for the NCO competencies. This corresponds with the remarks of some participants of the experimental group, that the way information should be shared as illustrated by the Multi-mono guide was not new for them. This can be explained by the participatory approach we used in developing the tool, integrating the knowledge and experience of crisis team members. Some of the participants mentioned that the Multi-mono guide could be a very helpful tool for inexperienced crisis team members. Therefore, it could be interesting to test the Multi-mono guide with trainees.

Even though the participants are very experienced, the scores show that there is room for improvement. Participants mention that the Multi-mono guide makes them aware of sharing information. However, the observations point out that information is not always shared at the right time, in both conditions. This leads to the second explanation: Possibly, the learning effect with the Multi-mono guide in the e-learning tool was not sufficient. This may be due to the content of the e-learning (e.g., the crisis situations that were used as example) or the learning time.

The third explanation for the fact that we did not find any differences on TSA and NCO competencies might be that the events in the scenario for which information sharing was necessary, were too obvious for these experienced participants. Most of the events concerned safety (like the leaking diesel that turned out to be petrol). Crisis management teams are really well trained to recognize events that affect safety and to communicate this immediately. The scenario should include events, which are not that obvious that they should be shared immediately. It should contain events that are more difficult to interpret. In addition, the question is whether training with the Multi-mono guide supports team member in sharing information during an actual crisis. From previous research we know that stress negatively influences sharing information. The study of Driskell, Salas en Johnston (1999) points this out: "…team members were less likely to maintain a broad team

perspective under stress and were more likely to shift to a more individualistic self-focus, resulting in poorer overall team performance". The scenario used and the setting was not experienced as stressful to the experienced team members. However, during an actual crisis, there is more time pressure and stress will be experienced. The risk that less information will be shared between disciplines is higher in stressful situations of an actual crisis. The Multi-mono guide creates awareness and helps building routine in determining whether information should be shared.

The last explanation concerns the research method of this experiment. Since questionnaires were used, it could also be the case that the tool does improve information sharing, but the participants do not perceive it as such. This is supported by the observations, showing that in the experimental group participants referred to the need of information sharing somewhat more. Another limitation is the small sample size. This enlarged the chance for type II errors: accept the null-hypothesis of no relationship between variables, when in fact it should be rejected because there are relationships.

Based on these explanations, we recommend to improve the content of the e-learning tool and extend the learning time. Moreover, the Multi-mono guide should be tested in more scenarios and in scenarios with different difficulty and stress levels. Furthermore, the applicability of the e-learning tool with the Multi-mono guide for training should be investigated. Finally, further research is needed to investigate whether the ideas of the Multi-mono guide can be generalized to different teams, but also to sharing information between hierarchical levels within the crisis management organization.

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