

## IMPROVING TACTICAL DECISION MAKING THROUGH CRITICAL THINKING

Karel van den Bosch & Anne S. Helsdingen  
TNO Human Factors  
Soesterberg, the Netherlands

Expert military commanders construct an initial but comprehensive interpretation of complex or unfamiliar tactical situations (story). They subsequently adjust and refine this story by evaluating available information, by searching for consistency, and by critically testing underlying assumptions. This approach is used to develop critical thinking training. Two effect studies were conducted. Individual commanders (study 1) and commanding teams (study 2) played scenario-based exercises in both simplified and high-fidelity task environments. Half the group received instruction, guidance, and feedback in critical thinking. The other half received the same scenarios, but without any support. After training, test scenarios were administered to both groups. Results showed positive effects on the process of tactical command (i.e. better argumentation for situation assessment) as well as on the outcomes (i.e. more and better contingency plans). The method supports not only individual commanders, it also helps teams to develop a common understanding of the situation and to co-ordinate team actions.

### INTRODUCTION

As a result of changes in the international political situation, military missions are more and more focused upon peace-enforcing operations in regional conflicts. There is often uncertainty about the intentions, capabilities and strategies of the parties involved. The successful preparation, execution and management of military operations in such unstable and complex conditions require competent commanders and staff personnel. Because tactical command and control is a core competency of the armed forces, the available attention and resources to train personnel should be used as effectively as possible.

Recently acquired knowledge on how experts solve real-world tactical problems has led to a new and effective concept of training. Expert decision makers have large collections of schemas, enabling them to recognise a large number of situations as familiar. Another capacity of experts are their problem solving skills that are required if an immediate match between the actual problem situation and available schemas in memory cannot be established. When faced with a complex and unfamiliar tactical problem, experts collect and critically evaluate the available evidence, seek for consistency, and test assumptions underlying an assessment. They thus try to integrate the results in a comprehensive, plausible, and consistent story that can explain the actual problem situation. The expert's approach is used to develop a new training concept: *critical thinking* (CT) (Cohen, & Freeman, 1997; Cohen, Freeman, & Thompson, 1997; Cohen, Freeman, & Thompson, 1998).

The aim of critical thinking training is to keep trainees from assessing situations solely on isolated events. Instead, trainees are taught how they can integrate the available information into its context, which may include elements as: the history of events leading to the current situation, the presumed goals and capacities of the enemy, the opportunities of the enemy, etc. Trainees are instructed how to identify (in)consistency and uncertainty, and how to adjust or refine their story by deliberate testing and evaluation. Critical Thinking training also includes a procedure for handling time constraints.

Effects of critical thinking training have been studied in a series of explorative studies (e.g. Cohen & Freeman, 1997; Klein, McCloskey, Pliske, & Schmitt, 1997), with encouraging results. In these studies, performance of CT-groups was compared to that of control groups that did not receive training exercises. They instead participated in activities that are not very relevant to tactical command, like filling out psychological test forms, or discussing work related issues. This allows for the possibility that not critical thinking, but mere participation in scenario-based exercises accounts for the observed effects. Furthermore, critical thinking training has been studied mostly in simplified task environments, concentrating on individual commanders, whereas tactical command is typically performed in a team.

This paper presents two studies into the effects of critical thinking. The first study investigates the question whether scenario-based critical thinking training leads to better improvement in tactical command than mere participation in

the exercises. The second study investigates the effects when the concept is applied to the training of command teams operating in their natural task environments.

**STUDY 1**

The first study is conducted in the domain of “air defence” of the Royal Netherlands Air Force, in particular the Tactical Command Station (TCS) of a ground-to-air defence battalion. In an office room, trainee-officers played air-defence scenarios under supervision of a scenario leader (see Figure 1).



**Figure 1: Training setting**

The trainee played the role of battle captain, the scenario leader played all other functions (lower and higher control), and introduced the -prespecified- events in the scenario (e.g. battle damage reports, information about enemy movements, identified radar tracks). Prior to each training scenario, the trainee was provided with a short description of the political, military, and civil background situation. Ambiguous, incomplete and inconsistent information was intentionally introduced into the scenarios to allow for alternative interpretations of events.

**Method**

*Design:* A training-posttest design was used (see Table 1). The supervising project officers arranged participants according to their tactical education and experience, and assigned matched pairs of trainees randomly to conditions.

*Briefing and instruction:* the critical thinking group received a critical thinking tutorial, followed by a demonstration in which two scenario leaders (one of them played the role of trainee) showed how critical thinking should be used in the scenarios. Trainees of the control group were instructed to run the scenarios as a normal command post exercise.

*Training general:* Two sets of three scenarios were used. Two scenario leaders were available. Order of scenario sets, and assignment of sets to scenario leaders was balanced. While performing the scenarios, trainees were asked to think aloud to give the scenario leader access to the assumptions and reasoning underlying the assessments and decisions. At pre-specified moments, the scenario leader “frozen” the scenario for interventions (see below). After each scenario, the scenario leader filled in an evaluation form.

*Critical Thinking group:* critical-thinking supporting schemes were available during training. At scenario freezes and after completing the scenario, the scenario leader provided support and feedback on the critical thinking process (e.g. by asking “which alternative explanations are possible?”, or “how can you verify that assumption?”).

*Control Group:* trainees received outcome feedback only (e.g. “that was a good decision”, or “you should have issued that request earlier”).

*Test:* Two test scenarios and two scenario leaders were available. Order of scenario and assignment of scenario to scenario leader was balanced. All trainees were asked to think aloud. No support or feedback was given.

Condition	Instruction	Training	Test
Critical Thinking-group (N=8)	Instruction and demos in critical thinking	Scenarios 1-6, with support in critical thinking process- and outcome feedback	Scenarios 7-8; without support; no feedback
Control-group (N=8)	No specific instruction	Scenarios 1-6, no support outcome feedback only	Scenarios 7-8; without support; no feedback

**Table 1: Research design**

*Performance measures:* outcome measures were used to assess the quantity and quality of the end result (what is actually achieved?); process measures to describe the strategies, steps or procedures used to accomplish the task. *Result and contingency plans* were used as outcome measures; *information processing* and *argumentation* as process measures. Scenario leaders evaluated trainee performance on these variables on a 10-point scale. A verbal description was used for each scale point, ranging from “very poor” for score 1, to “excellent” for score 10. Prior to the experiment proper, scenario leaders had used the results of a pilot-study (using the same scenarios but with different trainees) to come to a common understanding of assigning scores.

## Results

Analyses of the training data showed that trainees of the critical thinking group performed better than trainees of the control group ( $F(4,11)=4.5, p<.05$ ). Both groups improved their performance over training ( $F(20,280)=1.8, p<.05$ ), and the amount of improvement was equal. Figure 2 shows the results on the test scenarios.

Significant differences between groups were found for *information processing*, *argumentation*, and *contingency plans* ( $F(1,14)=7.2, 6.7, \text{ and } 6.3$ , respectively, all  $p's<.05$ ). The variable *result* showed a similar pattern, but the difference between groups was not significant ( $F(1,14)=1.8, p=.2$ ).

## Discussion

Trainees of the *critical thinking* group performed better than the control group already at the first stage of training, and continued to do so throughout the training program. This indicates that the instruction to follow the critical thinking approach is in itself a sufficient impulse for improving the quality of tactical command. The results of the study had practical implications for the military training organisation as well. The scenario leaders discovered that this form of training disclosed gaps in tactical education of the participating officers that had remained concealed in the large-scale exercises constituting normal training.

The outcomes corroborate the positive outcomes of earlier explorative studies (e.g. Cohen & Freeman, 1997; Klein et al., 1997). However, further research is needed to investigate a number of questions. First, scenario leaders' scoring may have been biased by their knowledge of the training intervention and the design of the study. More independent assessments are needed. Second, the effect of training has been studied in a simplified task environment. Eventually, critical thinking skills need to be applied in the real world. For reasons of transfer it is necessary to investigate whether critical thinking skills can be successfully trained in high-fidelity task environments. Finally, the training of the first study focused upon the individual commander, whereas tactical command is typically performed in a team. The effects of critical thinking training for teams need to be determined. These questions are addressed in study 2.

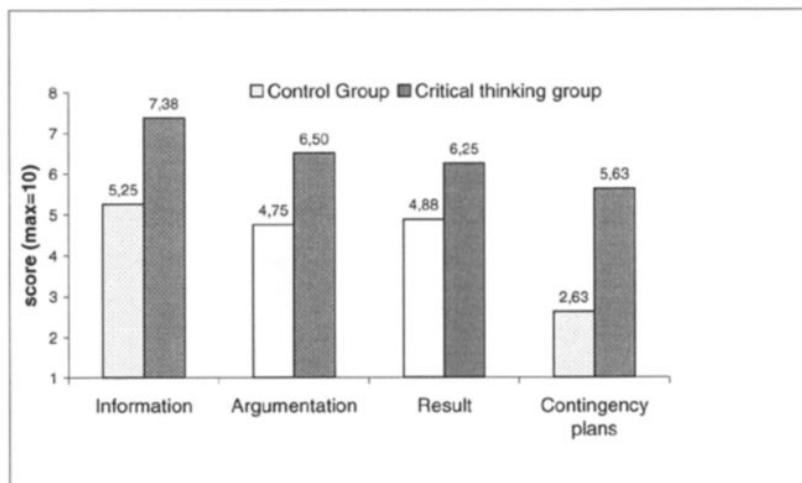


Figure 2: Results on the test scenarios

## STUDY 2

This study investigates the effects of critical thinking applied to the training of command teams operating in their natural task environments. It is conducted in the domains of “anti air warfare” (AAW) and “anti surface warfare” (ASW) at the Operational School of the Royal Netherlands Navy. Teams of trainees played single ship / single threat scenarios in a high-fidelity tactical simulator. The ASW and AAW teams consisted of an officer and petty officer.

### Method

*Design:* A training-posttest design was used. The supervising project officer arranged the eight participating teams according to their tactical education and operational experience, and assigned matched pairs of teams randomly to either the “critical thinking training” group or the “control” group. The supervising project officer selected two instructors for the study. They were randomly assigned to conditions.

*Briefing and instruction:* Prior to the experiment proper, instructors assigned to train “critical thinking training” teams were extensively briefed on the critical thinking training method, as well as how to support trainees in the application of critical thinking processes. Instructors assigned to the control team were not informed about the concept of critical thinking. They were told to support the teams as they would normally do in training. Instructors trained one team at a time. The briefing, training and testing required four days per team. The first day of the actual study was used for briefing and instruction of the teams. The experimenter and the assigned instructor briefed the “critical thinking” team on the principles of critical thinking and showed them how to apply this principle in paper-based demonstration scenarios. The control group instructor briefed his team on the itinerary of the coming days, and discussed a paper-based demonstration scenario with them.



Figure 3: Training in the tactical simulator

*Training general:* On the second day, teams received two interactive role-playing scenarios in a staff room under supervision of their instructor. On the third day, teams received two scenarios in the tactical simulator (see Figure 3). A scenario run took approximately two hours. See study 1 for details on how the instructor made interventions to support learning.

*Critical Thinking group:* The instructor encouraged his team to explicitly execute all critical thinking components and he provided extensive guidance and feedback during and after the scenarios.

*Control Group:* The instructor supported the control group teams as in normal training.

*Test:* On the fourth and final day, teams were tested on two test scenarios in the simulator. Instructors were not present. Two independent subject matter experts evaluated the performance of trainees individually, as well as that of the team. They received the scenarios on paper. Markers in the scenario description prompted the evaluators to score trainee and team performance at that particular moment, on specified performance criteria.

Evaluators were not informed about the concept of training nor of the purpose and the design of the study. Assignment of evaluators to teams and to scenarios was balanced.

*Performance measures:* the same outcome and process measures as in study 1 were used. In addition, performance with respect to *time management* and *team skills* (e.g. information exchange, communication, supportive behaviour and initiative/leadership) were also scored. Because the evaluators were used to using the official NATO 4-point scale, it was decided to use this 4-point scale in this study as well. The verbal descriptions for the four scale points are, respectively: UNSatisfactory, MArginal, SAtisfactory, and EXcellent.

Prior to the experiment proper, the experimenter briefed the evaluators about the scoring procedure and how to use the scale. The results of a pilot-study were used to arrive at a common interpretation of performance measurement.

### Results

Data on individual as well as on team performance were collected during training and test. For reasons of brevity, data on team performance on the two test scenarios will be reported only. Figure 4 shows the results on the test scenarios.

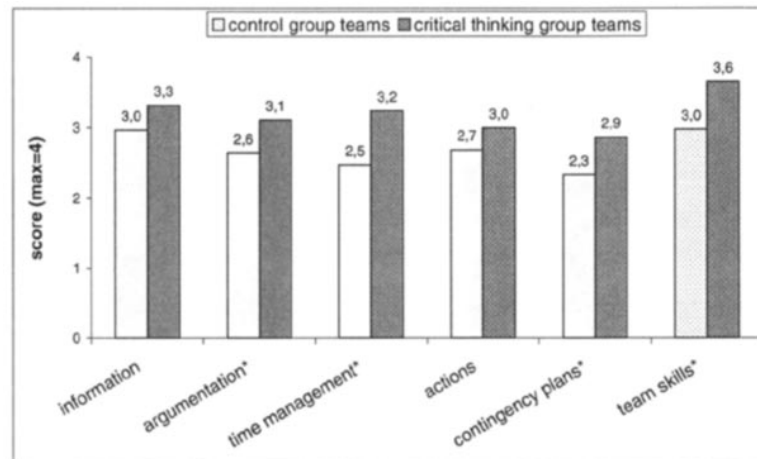


Figure 4: results on the test scenarios

Multivariate analysis showed that critical-thinking teams performed, over-all, significantly better than the control group ( $F(6,9)=6.8, p<.01$ ). Univariate tests showed significant differences for *argumentation* ( $F(1,14)=14.4, p<.01$ ), *time management* ( $F(1,14)=35.3, p<.01$ ), *contingency plans* ( $F(1,14)=9.3, p<.01$ ), and *team work* ( $F(1,14)=19.0, p<.01$ ).

#### GENERAL DISCUSSION

Critical thinking training produced positive effects on the *process* of tactical command (i.e. better argumentation for situation assessment) as well as on the *outcomes* (i.e. more and better contingency plans). The method supports not only individual commanders in situation assessment and decision making, it is also particularly suitable for team members to clarify their assumptions and perspectives on the situation to the other team member(s). This is especially important for developing shared mental models and to co-ordinate team actions (Stout, Cannon-Bowers, & Salas, 1996). The dynamic and interactive nature of high-fidelity simulator training sometimes provides too little opportunity for the object of this type of training: reflective and critical task performance. This can be overcome by preparatory paper-and-pencil- and role-playing scenarios, and by introducing pauses in the simulator-scenarios.

The present and earlier studies (Cohen, & Freeman, 1997; Cohen et al., 1997; Cohen et al., 1998; Freeman & Cohen, 1996) now provide sufficient evidence warranting the implementation of this type of training in practical (military) training programs. Such implementation studies are needed to provide answers to important questions, like: "how can we integrate critical thinking training into an existing

curriculum?", "what instruction and training do observer/trainers need for successful application (*train the trainers*)?", "what is the transfer of training?", and "what are the long-term effects?"

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