Improving perceptual judgement for recognizing improvised explosive threats

Assessment of the effectiveness of the environment familiarization and indicator trainer

Vladimir Zotov
Jerzy Jarmasz
Matthew Lamb
Dorothy Wojtarowicz
DRDC - Toronto Research Centre

Defence Research and Development Canada

Scientific Report
DRDC Toronto TR 2013-155
October 2014

Improving perceptual judgement for recognizing improvised explosive threats

Assessment of the effectiveness of the environment familiarization and indicator trainer

Vladimir Zotov
Jerzy Jarmasz
Matthew Lamb
Dorothy Wojtarowicz
DRDC - Toronto Research Centre

Defence Research and Development Canada

Scientific Report
DRDC Toronto TR 2013-155
October 2014

IMPORTANT INFORMATIVE STATEMENTS

This work was performed under the IED Awareness Project (12RR03, CIED TDP).

The data collected as part of this study was approved either by Defence Research and Development Canada's Human Research Ethics Board or by the Director General Military Personnel Research & Analysis' Social Science Research Review Board.

Abstract

Improvised Explosive Devices (IEDs) pose a significant threat to the safety of Canadian Armed Forces (CAF) personnel currently deployed in overseas missions. Anecdotal evidence indicates that experienced convoy crews develop an intuitive sense of potential IED threats in unfamiliar terrain. The Environment Familiarization and Indicator Trainer (EFIT) is a tool developed by DRDC Toronto in an attempt to train this intuitive IED detection capability. EFIT provides cultural familiarization of the operational terrain by exposing troops to real video of convoy operations integrated with current high-resolution satellite imagery and vector data. A study was conducted to evaluate EFIT's effectiveness as a training tool for recognizing and detecting indicators of IED threat in a realistic environment. Participants were asked to perform two separate, video-based threat perceptual/judgment tasks, and their responses were compared to those of CAF troops with previous operational experience with IEDs in Afghanistan, in order to determine whether EFIT training improved their baseline IED threat assessment skills. Participants who trained with EFIT improved in their ability to distinguish between lower and higher IED threat situations (as determined by a panel of experts), relative to participants who did not receive the training. Feedback from the participants showed that they gained a better understanding of the specific IED indicators and the general contextual clues of IED-related threats. This study indicates that training with EFIT can augment the mission-specific C-IED training already provided by the CAF.

Significance to defence and security

Improvised Explosive Devices (IEDs) pose a significant threat to the safety of Canadian Armed Forces (CAF) personnel deployed military operations. The CAF are thus interested in improving training of counter-IED (C-IED) skills. Anecdotal evidence indicates that experienced convoy crews develop an intuitive sense of potential IED threats in unfamiliar terrain. Often crews will correctly determine that an IED threat is present even if there does not appear to be obvious indicators of that threat. The Environment Familiarization and Indicator Trainer (EFIT) is a tool developed by DRDC Toronto, as part of the Omnibus Counter-IED Technology Demonstration Program (TDP), in an attempt to train this intuitive IED detection capability. EFIT provides cultural familiarization of the operational terrain by exposing troops to real video of convoy operations integrated with current high-resolution satellite imagery and vector data. This study aims to evaluate EFIT's effectiveness as a training tool for recognizing and detecting indicators of IED threat in a realistic environment.

Participants for this study were drawn from the Battlegroup of Task Force (TF) 3-09, participating in Exercise BRAVE RAM, at CFB Edmonton in August 2009. The control group received only the standard training provided by TF 3-09 trainers, whereas the experimental group received additional training with EFIT. Participants were asked to perform two separate, video-based threat perceptual/judgment tasks, and their responses were compared to those of CAF troops with previous operational experience with IEDs in Afghanistan, in order to determine whether EFIT training improved their baseline IED threat assessment skills.

Participants who trained with EFIT improved in their ability to distinguish between lower and higher IED threat situations (as determined by a panel of experts), relative to participants who did not receive the training. Feedback from the participants showed that they gained a better understanding of the specific IED indicators and the general contextual clues of IED-related threats. This study indicates that training with EFIT can augment the mission-specific C-IED training already provided by the CAF. Therefore, CAF soldiers could be even better prepared to make sense of and "read" operational environments for threats with the adoption of this relatively simple and cost-effective training tool. There are no current plans by DRDC Toronto to continue to develop EFIT training videos. However, EFIT has been used informally by a number of CAF units preparing to deploy to Afghanistan. DRDC Toronto is working with the CAF to ensure that the capability to generate EFIT videos is retained by the CAF past the termination of the C-IED TDP.

Résumé

Les engins explosifs improvisés (EEI) constituent une menace importante pour la sécurité du personnel des Forces armées canadiennes (FAC) actuellement déployé dans le cadre de missions à l'étranger. Des preuves anecdotiques indiquent que les équipages de convoi chevronnés développent une certaine intuition en ce qui concerne les menaces potentielles d'EEI en terrain inconnu. Le Simulateur d'indices et de familiarisation avec l'environnement (SIFE) est un outil développé par RDDC Toronto dans le but d'entraîner cette capacité intuitive de détection des EEI. Le SIFE permet de familiariser les militaires avec le terrain opérationnel en exposant ceux-ci à des vidéos réelles des opérations de convois intégrées à une imagerie satellite à haute résolution et à des données vectorielles. On a réalisé une étude afin d'évaluer l'efficacité du SIFE comme outil d'entraînement permettant de reconnaître et de détecter les indicateurs de menace d'EEI dans un contexte réaliste. On a demandé aux participants d'effectuer deux tâches distinctes de perception et de jugement de la menace par vidéo, et leurs réponses ont été comparées à celles des troupes des FAC ayant une expérience opérationnelle antérieure des EEI en Afghanistan, afin de déterminer si l'entraînement au SIFE améliorait les compétences de base en matière de détection de la menace des EEI. Les participants qui s'étaient entraînés avec le SIFE avaient amélioré leur capacité à faire la distinction entre les situations de menace d'EEI élevées et faibles (selon ce qu'a déterminé un panel d'experts), par rapport aux participants qui n'ont pas reçu l'entraînement. La rétroaction des participants a laissé entendre qu'ils avaient une meilleure compréhension des indicateurs d'EEI spécifiques et des indices contextuels généraux des menaces liées aux EEI. La présente étude montre que l'entraînement au SIFE peut renforcer l'instruction C EEI propre à la mission qui est déjà donnée par les FAC.

Importance pour la défense et la sécurité

Les engins explosifs improvisés (EEI) constituent une menace importante pour la sécurité du personnel des Forces armées canadiennes (FAC) actuellement déployé dans le cadre d'opérations militaires. Les FAC sont donc intéressées à améliorer l'entraînement relatif aux compétences en matière de la lutte contre les EEI (C-EEI). Des preuves anecdotiques indiquent que les équipages de convoi chevronnés développent une certaine intuition en ce qui concerne les menaces potentielles d'EEI en terrain inconnu. Souvent, les équipages déterminent correctement la présence d'une menace d'EEI même s'il ne semble pas y avoir d'indicateurs évidents de ladite menace. Le Simulateur d'indices et de familiarisation avec l'environnement (SIFE) est un outil développé par RDDC Toronto, dans le cadre du Programme de démonstration de technologie (PDT) global de lutte contre les EEI, dans le but d'entraîner cette capacité intuitive de détection des EEI. Le SIFE permet de familiariser les militaires avec le terrain opérationnel en exposant ceux-ci à des vidéos réelles des opérations de convois intégrées à une imagerie satellite à haute résolution et à des données vectorielles. La présente étude vise à évaluer l'efficacité du SIFE comme outil d'entraînement permettant de reconnaître et de détecter les indicateurs de menace d'EEI dans un contexte réaliste.

Les participants de l'étude provenaient du groupement tactique de la Force opérationnelle (FO) 3-09, participant à l'exercice BRAVE RAM, à la BFC Edmonton en août 2009). Le groupe témoin n'a reçu que l'instruction standard donnée par les formateurs de la FO 3-09, tandis que le groupe expérimental a reçu un entraînement supplémentaire au SIFE. On a demandé aux participants d'effectuer deux tâches distinctes de perception et de jugement de la menace par vidéo, et leurs réponses ont été comparées à celles des troupes des FAC ayant une expérience opérationnelle antérieure des EEI en Afghanistan, afin de déterminer si l'entraînement au SIFE améliorait les compétences de base en matière de détection de la menace des EEI.

Les participants qui s'étaient entraînés avec le SIFE avaient amélioré leur capacité à faire la distinction entre les situations de menace d'EEI élevées et faibles (selon ce qu'a déterminé un panel d'experts), par rapport aux participants qui n'ont pas reçu l'entraînement. La rétroaction des participants a laissé entendre qu'ils avaient une meilleure compréhension des indicateurs d'EEI spécifiques et des indices contextuels généraux des menaces liées aux EEI. L'étude indique que l'entraînement au SIFE peut renforcer l'instruction C EEI propre à la mission qui est déjà donnée par les FAC. Par conséquent, les soldats des FAC pourraient être encore mieux préparés à donner un sens aux contextes opérationnels des menaces et à en faire l'interprétation grâce à l'adoption de cet outil d'entraînement relativement simple et rentable. RDDC Toronto ne planifie actuellement pas de poursuivre le développement des vidéos d'entraînement du SIFE. Toutefois, le SIFE a été utilisé officieusement par un certain nombre d'unités des FAC qui se préparaient à un déploiement en Afghanistan. RDDC Toronto travaille avec les FAC afin de faire en sorte que les FAC conservent la capacité à produire des vidéos du SIFE après la fin du PDT C EEI.

Table of contents

Abstract …….. i
Significance to defence and security ii
Résumé …….. iii
Importance pour la défense et la sécurité iv
Table of contents v
List of figures vi
List of tables vii
Acknowledgements viii
1 Introduction 1
1.1 The IED challenge 1
1.2 EFIT 2
2 EFIT validation study 5
2.1 Method 6
2.1.1 Participants 6
2.1.2 Apparatus and stimuli 6
2.1.3 Procedure 8
2.2 Results 10
2.2.1 Establishing benchmarks: SME data analysis 10
2.2.2 Short videos 13
2.2.2.1 IED emplacement task 13
2.2.3 Long videos 16
2.2.4 Demographics and feedback 17
3 General Discussion 20
3.1 Effectiveness of EFIT 20
3.2 Study limitations 20
3.3 EFIT & perceptual learning 22
3.3.1 General skills / PLMs 22
3.3.2 Perceptual learning for military training 23
References 25
Annex A Instructions 27
A.1 Demographics 27
A.2 Long video instructions 27
A.3 Short video instructions 28
A.4 Short video questions 28
A.5 Post-test questionnaires 29
A.6 Training video feedback questionnaires 30
List of symbols/abbreviations/acronyms/initialisms 31

List of figures

Figure 1	Model of IED Awareness and threat assessment.	4
Figure 2	Sample screenshot of an EFIT training video. The left frame shows video of the environment from the point of view of someone travelling in a convoy, the right frame shows a moving map indicating the location (yellow trace) and immediate surroundings of the convoy.	7
Figure 3	A sample of training video.	8
Figure 4	Mean responses for different SME groups to the IED emplacement and IED Threat rating tasks.	12
Figure 5	Participants performance Pre- and Post-test in short video task.	15
Figure 6	Participants performance Pre- and Post-test in long video task.	17
Figure 7	Participants ranking of feedback scores. Note that the "Learned New" means have been scaled to fit the range of the other responses (i.e., a 100% rating corresponds to a score of 5 in the figure).	18
Figure A.1	A pop-up instruction given prior to starting a short video test.	28

List of tables

Table 1 Experimental groups and the flow of the experiment. 10

Table 2 Intra-class correlations among SME groups in IED Emplacement and IED Threat tasks. 13

Table 3 Average feedback questionnaire item ratings, ordered from highest to lowest. . 18

Acknowledgements

The authors would like to acknowledge the following people for their assistance in designing, conducting, and analyzing data from the study reported here: MCpl Elena Scourtoudis, Cpl Nivin Joseph, MCpl Nick Field, Cpl Phil Mach, Dr. Matthew Duncan, Ms. Andrea Hawton, Ms. Brenda Fraser, Ms. Rachel Spiece.

Special thanks go to members of 32 Canadian Brigade Group who helped to select the video content that was used to produce the Environment Familiarization and Indicator Trainer (EFIT) prototype used in this study, as well as provided many of the learning points that were integrated into the accompanying instructor commentary. We are also very grateful to the members of 1 Combat Engineer Regiment, 1 Princess Patricia's Canadian Light Infantry, and the personnel at Canadian Forces Base Edmonton who facilitated our study and reviewed EFIT prior to the study. We also acknowledge the important contribution of Capt Don Fox (Combat Training Centre Gagetown), Maj Dan Schurman (Counter-IED Task Force), instructors from 2 Combat Engineer Regiment (CFB Petawawa) and Dr. Jocelyn Keillor (formerly DRDC Toronto, now at the National Research Council) in developing the early versions of what became EFIT.

1 Introduction

1.1 The IED challenge

- The "asymmetrical" nature of recent conflicts world-wide (i.e., conflicts opposing well-equipped formal armed forces and less-well equipped irregular or non-state-actor armed forces) has led to the proliferation of unconventional and improvised weapons systems. Perhaps the most notorious and deadly have been the improvised explosive devices (IEDs) which claimed the lives of so many Canadian Armed Forces (CAF) soldiers during Canada's combat mission in Afghanistan (2002 to 2011), and continue to claim soldiers' and civilians' lives in various conflicts world-wide. IEDs are particularly dangerous and difficult to counter for a number of reasons: they are designed to be deliberately difficult to detect, using various concealment and diversion tactics; they are constructed using non-standard and widely-varying materials, components and designs, and employed using widely variable tactics, making it difficult for conventional forces to systematically identify them and track them down (Zorpette, 2008). Furthermore, the irregular forces using IEDs will frequently alter their attack and construction methods in order to defeat the counter-measures employed by more conventional forces (Eles, 2009; Zorpette, 2008).

- Perhaps due to the highly variable and adaptive nature of IEDs, the considerable technological counter-measures that have been developed by various security and defence organizations world-wide have not been able to completely neutralize the IED threat. It is still the case that soldiers rely to a great extent on their own senses and powers of observation to notice and avoid IED attacks (Bruyn Martin & Karthaus, 2009; Zorpette, 2008). That is, soldiers require strong "IED Awareness" skills, which involve the following: the ability to visually identify IEDs, to respond appropriately to them, and to identify the environmental conditions (terrain, human behaviour) that favour or enable the emplacement of IEDs. It also involves recognizing environmental cues suggesting that an IED is likely to have been emplaced, or is in the process of being emplaced, in a given location. In more military terms, this involves the ability to assess the operational environment for locations insurgents are likely to use for IED emplacements as well as the threat of an IED attack at a given time and place.

- Anecdotal evidence from SMEs (documented in Bruyn Martin & Karthaus, 2009; and our own informal discussions with SMEs) suggests that soldiers deployed to IED threat environments do indeed learn from experience to better recognize and interpret cues in the environment that may indicate IED threats. This observation is supported by a study that compared the eye movements of experienced soldiers and civilians with no IED search training, and which found that experienced soldiers produced significantly more fixations to scenes in videos depicting potential IED threats than did civilians (Keillor, Jarmasz, Pavlovic & Lamb, 2007; the effect was replicated in Zotov et al, 2009). Further evidence for the learnability (at least through experience) of IED awareness skills was collected by (Murphy 2010) who did an extensive investigation of the individual differences that distinguish individuals proficient at spotting IEDs from those with no special aptitude in this area.

- Further discussions with SMEs (also documented in Bruyn Martin & Karthaus, 2009) indicate that a key aspect of "IED Awareness" is learning to interpret the environment in order to recognize things that are unusual or out-of-place. This ability to spot anomalies entails first being familiar with what is "normal" in a given environment, and then understanding the subtle perceptual cues (both physical and cultural) that indicate potential threats and anomalies. Appreciating what is "normal," and therefore, having an awareness of the "anomalous," is very context- and experience-dependent, and doing so in a theatre of operations can constitute quite a challenge for troops who have grown up and trained in very different environments (see Jarmasz, 2010, for a more extended discussion of the cognition of IED Awareness). The learning of this type of subtle perceptual patterns, prior to (or instead of) first-hand experience with the environment, is typically best supported with "rich media" materials (video, images) rather than text-based classroom instruction, and accordingly is often difficult to adequately support in institutional training settings (Guerlain et al., 2004; Kellman & Garrigan, 2009). Thus, on the assumption that IED Awareness skills exists, and can further be developed through experience, we created the Environment Familiarization and Indicator Trainer (EFIT), a training tool specifically designed to expose learners to the environmental cues that indicate potential IED threats using real video from operational environments.
- EFIT has been in development since 2007, and has undergone many iterations since then, including different user interface designs. However, as indicated above, its central feature is the use of real video to show an operational environment from the perspective of someone traveling through that environment in order to familiarize viewers with the appearance of that environment, and to help them recognize anomalies and potential threats in that environment. In the next section, we describe the most recent version of EFIT, which focuses on the environment and IED threats from the Kandahar province, the area of Afghanistan in which the CAF conducted the majority of its combat mission supporting Operation Enduring Freedom and the International Security Assistance Force in that country.

1.2 EFIT

As noted above, EFIT is a video-based training tool designed to familiarize trainees with the operational environment, as well as with combat indicators of unconventional threats (e.g., ambushes or IEDs) in realistic contexts, by showing a first-person view of terrain in a given area of operations. The video "feed" can be augmented with a number of other features to enhance its training value. Most notably, special effects can be added to the video to highlight specific objects or areas in the video (e.g., with oval overlays or masks) or to make the whole scene easier to take in (e.g., a slow-motion effect). A moving map can also be added which indicates the progress of the video's viewpoint through a terrain (in our case, this was typically the view from a vehicle driving on roads of various types in Afghanistan). The map can thus familiarize soldiers with routes they might travel during their deployment, and the video shows them what the routes will look like from a first-person perspective. The map can also be used to provide additional information not readily apparent in the video, such as important landmarks or geographic features outside its field of view, or the locations of previous IED strikes (which are known to be commonly re-used by insurgents; see Bruyn Martin & Karthaus, 2009, and Eles, 2009). A recorded voice-over of instructor or SME commentary can also be added to replace any ambient sounds captured with the video. This allows viewers of EFIT to learn from others who have experienced the environment and the threats therein first-hand. The original audio can be retained (possibly as an optional sound track) in order to expose viewers to typical in-cabin crew communications or ambient sounds typical of the locale captured in the video (providing these sounds were recorded with the video and are of adequate quality). The design of EFIT was guided by substantial feedback from SMEs and potential end users throughout the duration of the project (see discussion in Lamb, Mach, Jarmasz & Wojtarowicz, in progress).

Given the relatively broad parameters of the EFIT concept, specific EFIT videos can be tailored to a variety of use cases and training requirements. For the final version of the EFIT prototype training videos produced by the IED Awareness Training project, the following design decisions were made:

- Two types of videos were produced: 1) "ride-along" videos, which showed travel down a particular road and included a moving map, and 2) "scenario" videos which illustrated specific IED emplacement scenarios with brief clips providing multiple examples of the same scenario, but without an accompanying map. Both video types made use of visual effects (highlights, slow-motion).
- All the videos focused on the environment and IED indicators from the perspective of mounted operations (i.e., convoy vehicles). This choice was made because, for most of the CAF's combat mission in Afghanistan, convoys were the main target of IEDs.
- The videos were confined to Unclassified materials for ease of production and distribution (e.g., during testing and trials). As a result, no sensitive materials were used, and in particular, no actual IED detonations or finds were shown. Nevertheless, the videos contained enough materials for SMEs to identify and/or illustrate situations with higher and lower threat levels for instructional purposes.
- Teaching points were conveyed in scripts, which were read by voice actors and recorded in replacement of the ambient audio for all videos. For a few of the videos, a version with original ambient audio (including cabin crew communications) was also produced, and were made available as an option alongside the videos with the instructional voice-over.
- Selection of the videos and the teaching points conveyed in the audio track were developed through extensive consultation with SMEs and using an analysis of IED attack patterns in Kandahar province by DRDC Center for Operational Research and Analysis (CORA) (Eles, 2009).

The instructional approach taken in the videos was designed to foster a "mindset" for maintaining alertness and assessing the situation for threats, rather than prescribing a list of specific cues indicative of IED attacks (called "combat indicators" in CAF doctrine) that should be looked for at all times. This is because IEDs are so variable in their design and manner of use that there is no set of perceptual cues that indicates that an attack is imminent in a completely reliable and deterministic way (see also Jarmasz, 2010). There do seem to be, however, general patterns that are associated with large proportions of attacks, but which vary in their details according to specific context (Eles, 2009). These general patterns pertain mostly to the environmental conditions that facilitate certain types of attacks over others in a given region (e.g., paved roads make it harder to emplace pressure-activated IEDs than do dirt roads). Thus, we organized the teaching points around two themes: the relatively generic and enduring environmental conditions that favour attacks (IED emplacements), and the more variable and contextual cues (changes in human activity or local features) that indicate that an attack might be imminent. This is summarized in Figure 1.

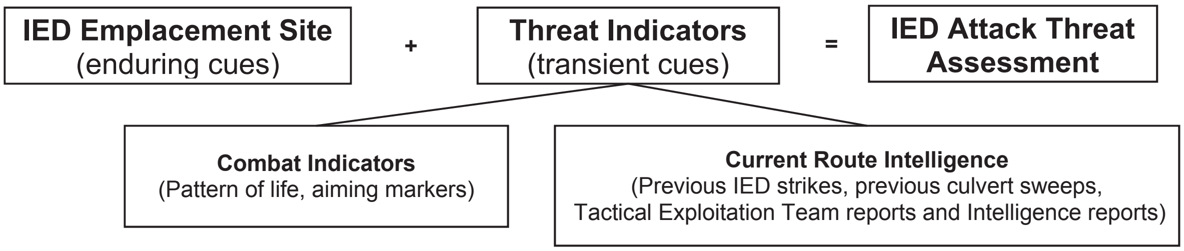

Figure 1: *Model of IED Awareness and threat assessment.*

The video footage of Afghanistan terrain at our disposal contained many examples of the features associated with emplacement sites for different types of IED attacks. Thus, recognition of the environmental features supporting different types of attacks could be amenable to training with the "Perceptual Learning Module" (PLM) approach described by Kellman & Garrigan (2009); (see also Guerlain et al., 2004). The PLM approach is based on the notion of "perceptual invariants" from ecological psychology (Gibson, 1979), which represent the geometric properties of environmental objects that remain the same regardless of viewing angle and context, and which allow people to recognize them across a variety of situations. The PLM notion extends the perceptual invariant notion to dynamic patterns, and proposes that by showing people the same dynamic pattern from a variety of viewpoints and in a variety of contexts, people will implicitly learn the invariant properties of the pattern and learn to recognize them in most contexts. Accordingly, the EFIT videos were designed to help soldiers recognize the "invariant" (i.e., generic and relatively enduring) aspects of terrain configurations that are associated with particular classes of attacks by showing multiple instances of such configurations (e.g., many examples of a culvert on a paved road) throughout the videos. The set of short "scenarios" videos was designed with the express purpose of explicitly demonstrating the "invariant" aspects of IED emplacement configurations, with each video focusing on examples of a specific type of terrain configuration, whereas the set of longer "ride-along" videos demonstrated the "invariants" of IED emplacement configurations more implicitly, by showing them in the wider context of driving on roads containing multiple potential IED emplacement sites.

Due to the security restrictions mentioned above, the videos we produced did not contain visible insurgent or IED emplacement activity. However, by showing potential IED emplacement locations in their normal context, they provided a platform for a discussion of possible indicators of IED attacks by an SME. Thus, the instructor voice-over added to the set of "ride-along" videos focused on such a discussion, emphasizing the need to consider indicators of an attack in light of the real-time context of an actual mission (including current intelligence assessments and information from other crew members), rather than providing a "laundry list" of indicators to look for by rote. Unlike the "invariants" of IED emplacement configurations discussed above, the indicators of an imminent or potential attack are highly variable and context-sensitive, and are thus the aspect IED Awareness that is most difficult to convey in a strictly procedural and systematic manner. They are also the most time-sensitive aspect of the knowledge that soldiers draw on to assess IED threat, and therefore the aspect of EFIT that is most likely to fall out-of-date. An advantage of separating the information conveyed with EFIT into the more enduring "invariants" of IED emplacement sites and the more variable IED attack indicators is that, as the specifics of attack patterns and techniques change, older video footage can be retained to continue to illustrate the generic features of IED emplacements, while the instructor voice-over and visual effects can be modified to explain the latest attack indicators observed in theatre.

To date, seven "ride-along" videos, each approximately five to seven minutes long, and four shorter "scenario" videos (about one to two minutes each) EFIT training videos have been produced, focusing on the IED threat in Kandahar province. They have been designed to be used as stand-alone videos that play on standard computer equipment or DVD players, as well as Flash-based (Adobe Inc., San Jose, CA) application that can be run on any Flash-enabled computer and which could be adapted to be delivered over computer networks. The videos can be used in a variety of settings (e.g., classroom instruction, or instructor-led discussion, self-paced individual training). The existing EFIT videos have been used in pre-deployment training by three Task Forces deploying to support the International Security Assistance Force (ISAF) combat mission in Kandahar Province, Afghanistan (TF3-08,TF3-09, TF1-10), the first Rotation of CAF soldiers supporting OP ATTENTION, the ISAF training mission in Kabul, at the Peace Support Training Centre, and by deployed personnel in theatre. Personnel in the armed forces of allied nations (United States, United Kingdom, Australia, New Zealand and the Netherlands) have also expressed an interest in, and received copies of, the EFIT training videos.

The enthusiastic but informal adoption of EFIT by various groups naturally raises the question of whether this enthusiasm is warranted – that is, it is necessary to determine whether EFIT is in fact effective as a tool for training IED Awareness. Accordingly, the following sections of this report present a study we conducted to examine this very question.

2 EFIT validation study

We conducted a study designed to determine whether EFIT training videos can improve soldiers' IED Awareness skills, specifically, their ability to distinguish situations that represent higher and lower threat of an IED attack in an operational environment. Our original intention was to do a direct comparison between EFIT and the C-IED components of the Theatre Mission-Specific Training (TMST) provided to troops deploying to IED threat environments (much of which is captured in the CAF's handbook on C-IED operations, Department of National Defence, 2010). However, given that the C-IED component of TMST covers much more material than IED Awareness alone (e.g., the tactics, techniques and procedures, or TTPs, of conducting systematic searches or of responding to IED incidents), and due to a number of practical constraints, we instead decided to assess whether EFIT can improve the IED Awareness skills of soldiers who have already completed the C-IED component of TMST. That is, we examined whether training with EFIT could improve the threat assessment skills that soldiers have already developed during TMST. Given our model of IED Awareness knowledge in Figure 1, we were specifically interested in whether training with EFIT would improve soldiers' ability to correctly assess (1) whether a particular location was well-suited to stage an IED attack, and (2) the threat of imminent attack in a given location at a given time. In order to evaluate participants' performance in these tasks, we asked them to identify potential IED emplacement sites and assess the threat of imminent attack in two separate video-based perceptual judgement tasks, using real video footage from CAF convoy patrols in Kandahar Province in Afghanistan. Participants' responses were compared to those of SMEs with prior operational IED experience in Afghanistan viewing the same videos.

We hypothesized that, after receiving training with EFIT, participants' performance in the IED emplacement and threat levels judgement tasks would become more similar to the SMEs' performance on the same tasks. This would suggest that EFIT is effective in instilling in soldiers with no operational experience with IEDs some of the IED awareness skills developed by SMEs during their operational tours, even when soldiers have previously received theoretical CIED training.

2.1 Method

2.1.1 Participants

126 Regular Force soldiers (active duty, age ranged from 18 to 60 years) meeting standard vision and health requirements participated in this study at Canadian Forces Base (CFB) Edmonton as part of their theatre mission-specific training (TMST) for deployment as part of Task Force 3-09 of the CAF's contribution to the ISAF combat mission in Afghanistan. The participants were primarily recruited from Charles Company, 1st Battalion, Princess Patricia's Canadian Light Infantry, with three participants from other units (two from 1 Field Ambulance and one from the Seaforth Highlanders of Canada respectively). Thus, while the participant pool reflected mostly a single Army Combat Arm, it also reflected one of the Combat Arms that was the most affected by IEDs. Thirty-one of the participants self-identified as having been deployed to Afghanistan in the 3 years preceding the study. These soldiers were asked to act as subject matter experts (SMEs) and to perform the task once (but not undergo the training) in order to provide baseline responses against which to compare the participants' responses. The investigators' experiences with SMEs show that assessment of IED indicators and threat situations can vary considerably from SME to SME (Jarmasz, 2010; Zotov, Keillor, Scourtoudis, Chen, Jarmasz, & Boyne, 2009), thus the largest possible number of SME responses is desirable in order to obtain a stable set of reference responses.

The study took place during the final stages of TMST before deployment, on a day where the participants were having a break in their schedule. All had completed their "standard" (CAF-provided) theatre-specific CIED training by that point, which included classroom and field components. As mentioned above, the question examined by the study was whether adding EFIT to the existing CIED curriculum in TMST improves IED awareness skills in comparison to the CIED instruction alone. Participants were made available to us by their chain of command as platoons (approximately 30 soldiers), and each platoon was assigned to one of two training conditions and one control condition with 34, 31, and 28 participants respectively. The reason for having two experimental groups was to test different delays between receiving training video and testing participants' ability to perform the task. The participants in the control condition only received the introductory C-IED brief, that is, they did not view the training videos during the study proper (they did, however, view the video after they participated in the study, at the request of their Commanding Officer).

2.1.2 Apparatus and stimuli

Training videos were presented with software developed in-house (using the Visual Basic programming language) to display the videos in the correct order, using both laptop and desktop computers running the Windows XP operating system (details on the sequencing of the videos are provided in the Procedure section). The software also collected responses from the participants (see the Procedure section for the responses that were collected). Each participant was provided with headphones to listen to audio instruction in the training videos. A sample screenshot of an EFIT training video (showing the video of the environment side-by-side with the map) is shown in Figure 2.

Figure 2: *Sample screenshot of an EFIT training video. The left frame shows video of the environment from the point of view of someone travelling in a convoy, the right frame shows a moving map indicating the location (yellow trace) and immediate surroundings of the convoy.*

Two types of videos were presented to participants: evaluation and training (EFIT) videos. Both types of videos showed footage of the operational environment from the point of view of CAF convoys operating on rural and urban roads in Afghanistan. The evaluation videos ("Test videos") served to assess subject performance before and after receiving EFIT training videos. There were two types of Test videos: short video clips approximately 20 s each (14 videos in total) and longer video clips approximately 180 s each (3 in total). The short videos consisted of a single convoy driving episode which included a potential IED incident; the depicted locations varied in terms of their "appropriateness" as an IED attack location (ease of concealment, degree to which the intended target would be immobilized, availability of aiming markers, etc.) and were categorized as either potential targets or foils (equally distributed between both categories, as rated by SMEs with experience in theatre from 32 Combat Brigade Group, prior to the study). These videos served to evaluate participants' detailed assessments of the threat level and type (i.e., IED type) in discrete episodes. The longer videos depicted a continuous stretch of road which contained a number of potential IED emplacement locations, which participants had to identify in real time (i.e., without pausing the video to inspect a location). These longer videos served to test participants' ability to rapidly assess a continuously evolving threat picture under conditions similar to those experienced in a vehicle traveling on a road in the operational environment.

Similar to the Test videos, the EFIT training videos used in the experimental condition consisted of video clips, recorded from vehicles in CAF convoys, showing different environments from the Kandahar theatre of operations. Unlike the Test videos, EFIT videos were augmented with a side-by-side map showing the convoy position, as described above, and visual cues highlighting features of interest overlaid on the video, as seen in Figure 3. The EFIT videos were also accompanied by an audio track consisting of expert commentary on the situations shown in the video. All training videos were approved for use in the study by 1 Combat Engineer Regiment, the organizers of, and training authority for, the C-IED training at Exercise BRAVE RAM.

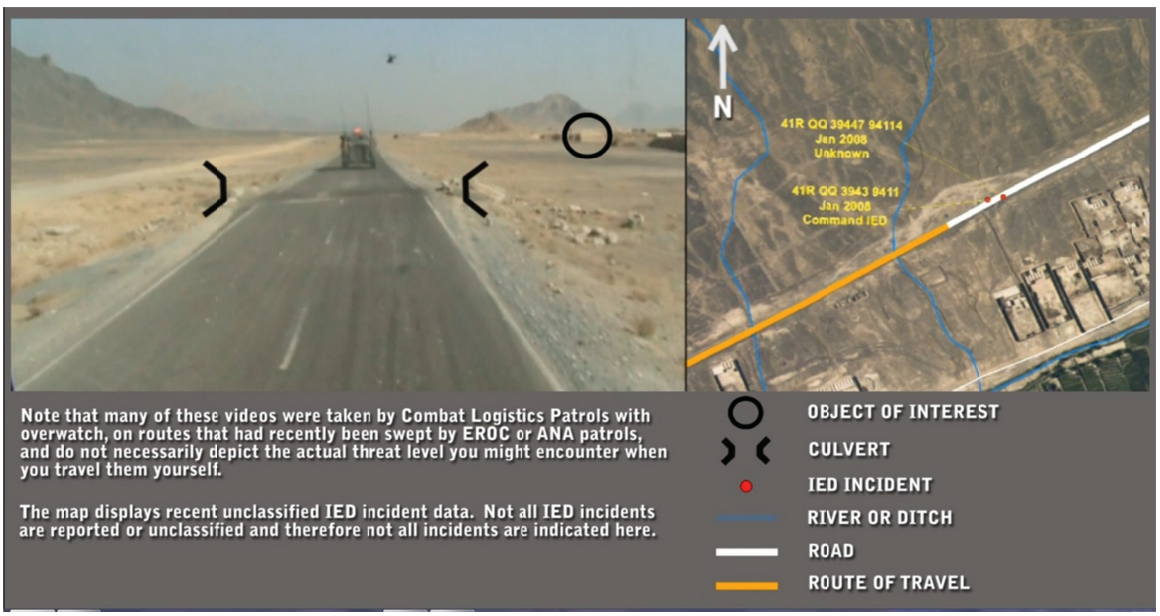

Figure 3: *A sample of training video.*

2.1.3 Procedure

Prior to starting the experimental session, participants received an introduction to the study and an information sheet that outlined their rights as participants and the task requirements; after reading the information sheet, volunteers gave their written consent to participate. Each group of non-SME participants (as determined by their platoon affiliation, discussed above) was assigned randomly to one of the experimental conditions or the control condition. The experimental groups received EFIT training between their pre- and post-tests assessing their IED Awareness skills (described below); one experimental group ("Training1") received the post-test as soon as they completed the EFIT training, whereas the second group (“Training2”) was tested approximately 2 hours after they completed EFIT training. The control group did not receive any training between the pre- and post-tests, and attended to administrative duties during this time. As stated above, all participants had previously received conventional pre-deployment C-IED training. (We note that the Commanding Officer of the troops participating in the study decided, after seeing the EFIT videos, to have the control group also receive EFIT training; however, this was done after the post-test was administered. All groups therefore received EFIT training, but only the experimental groups received it before the final testing session).

The experimental session started with participants filling out computer-based questionnaires related to their demographic information and service experience (see Annex A.1). Participants began the pre-training test (“pre-test”) stage of the study by completing the threat perceptual/judgment task, which consisted of two phases.

In the first phase of the pre-test, participants were asked to watch the 3 long test video clips described above (durations of 200 s, 180 s, and 179 s respectively) and press and hold the spacebar whenever they felt the video depicted a good location to emplace an IED. Annex A.2 shows the instructions for this phase of the task. To preserve the uninterrupted flow of the video clip, similar to the experience of driving down a road in real life, pressing the spacebar did not interfere with the flow of the video. A text message (“Spacebar Pressed”) would appear below the video panel during the time that participants held down the spacebar, to give a positive indication that participant input was being registered, and the background of the box where this text appeared would change from beige to red (when the spacebar was not pressed down, the text below the video read “No Key Pressed Detected”).

In the second pre-test phase, participants were shown the 14 short video clips described above (duration ranging from 5 to 30 seconds), depicting locations of varying plausibility as a potential IED emplacement sites (i.e., the depicted location lent itself more or less to an attack based on ease of IED concealment, restriction of convoy manoeuvrability, etc.). After each video, they were asked to (1) determine whether the situation depicted was a good IED emplacement site (yes/no) and (2), rate the threat level of the situation on a 5-point scale (where 1 = low threat and 5 = high). For both questions, participants were asked to list briefly the indicators that lead to their assessment; finally, they were asked to select (from a comprehensive list of IED types) the type of IED they thought would be most likely to be employed in the depicted location. The instructions for this phase of the task are shown in Annex A.3, and the computerized response form is shown in Annex A.4. The identification of the type of IED was accompanied by a free text option for optional further input. SMEs were asked to participate in this pre-test task only, and to complete it only once, at an opportune time during the exercise.

Following the pre-test, the two experimental groups underwent training with the EFIT videos (lasting approximately 1 hour) before performing the follow-up post-test described above, whereas the control group performed the post-test (after a 1 hour break), and then viewed the EFIT videos. Note that the videos used in the pre- and post-tests were identical, save for the specific order in which they were shown. The flow of the experiment is summarized in Table 1.

Table 1: *Experimental groups and the flow of the experiment.*

Group	Pre-Test	EFIT	Break	Post-test	EFIT
Training1	Yes	Yes	No	Yes	No
Training2	Yes	Yes	Yes (2 hrs)	Yes	No
Control	Yes	No	Yes (1 hr)	Yes	Yes
SMEs	Yes	No	No	No	No

Upon completion of the post-training videos all three groups completed a questionnaire on their subjective impressions of the test tasks (Annex A.5); the participants in experimental groups also completed a questionnaire on their subjective impressions of the EFIT videos (Annex A.6).

The testing procedure was designed to capture two kinds of responses: rapid judgements in response to continuously evolving situations (i.e., IED yes/no emplacement judgements during the longer videos) and more detailed, considered judgements in response to discrete episodes (the shorter videos). This was done because IED threat judgements in operational settings are very often performed "on the fly" during situations where there is little or no time to stop and ponder (e.g., convoy or foot patrols). Thus, the yes/no judgements made during the longer videos are more representative of the judgements soldiers have to make in the field, however they provide little insight into the thought (cognitive) process behind the judgement. Thus, we included both judgements in our testing to supplement the "realistic" responses during the longer videos with the less realistic but more informative judgements during the short videos depicting discrete episodes.

2.2 Results

2.2.1 Establishing benchmarks: SME data analysis

As mentioned above, participants who had operational experience in Afghanistan in the 3 years prior to the study were selected as SMEs to provide “benchmark” or reference responses for the study. This was necessary because establishing an objective measure of IED Awareness performance was not possible, due to the insurmountable challenges to obtaining video of Afghanistan terrain with identified/known IEDs emplaced. Our next-best option was to compare participants’ assessment of the suitability of the terrain for IED emplacements and perceived threat levels to the same judgements produced by experienced troops. We thus collected responses to the video-based test tasks described above from SMEs and used the average responses as references against which to compare the experimental responses.

Using SME responses as a reference was not without issues, however. As mentioned above, and as reported elsewhere (Jarmasz, 2010; Murphy, 2010) there is reason to believe that soldiers’ judgements of IED threats varies according to the environment they operated in and their specific roles in theatre. In our sample, we knew that our participants had seen action in Kandahar province in Afghanistan, with a mix of urban and rural terrains. We also knew that our group of SMEs consisted of 3 groups, according to their roles in convoys:

1. A "Front" group (11 SMEs), consisting of soldiers who operated as vehicle drivers or crew commanders. These roles required them to constantly scan the road ahead of them for IED threats to the vehicle and the convoy.

2. A "Gunners" group (9 SMEs) consisting of soldiers whose role was to operate the vehicle's weapon system and to scan the environment, both in front of and to the sides of the vehicle, but typically further out than the "Front" group, for targets to shoot at (and thus not necessarily always IED threats, or even direct threats to the vehicles, so long as they were valid targets for the mission).

3. A "Rear" group (12 soldiers), i.e., infantry soldiers who had experience scanning for IED threats in a dismounted role, but who had very limited experience scanning for IED threats from within vehicles, often sitting in the passenger compartment of a Light Armoured Vehicle (LAV) III, where the only view onto the road was through the vehicle's (low-resolution) camera system or by looking out the sentry hatches (discouraged by standard operating procedures by the time we conducted our study, for safety reasons).

The Front group's experience scanning for IED threats most closely matched our conceptual model of IED Awareness, and, on theoretical grounds, we felt they would be the best group to provide the reference responses for the study. However, we were not aware of any quantitative data characterizing the effects of different types of operational experience on visual scanning for IED threats. Thus, while we had some a priori grounds for not using the whole SME sample as a benchmark for the experimental responses, we did not have empirical grounds for preferring one group of SMEs over the other. We therefore needed to analyze the SMEs' performance to determine whether their responses to the video test tasks varied according to group. We also wanted to determine whether the groups we formed on the basis of operational theatre roles provided internally consistent responses, which would further suggest that each group constitutes a cohesive sub-population of SMEs with consistent IED Awareness skills.

To determine whether the three SME groups differed, we performed ANOVAs on SMEs' mean responses to the IED emplacement ratings (yes/no responses) and the IED threat ratings (1-5 Likert scale) in the short videos (vignettes) test task. (We did not analyse the continuous responses in the long video task at this stage, due to the complex, time-series nature of the data). The ANOVA for the IED emplacement task narrowly failed to achieve significance, $p = .074$, $F(2,29) = 2.85$, $\eta^2 = .164$. Post-hoc analyses using Fisher's Least Significant Difference (LSD) Test showed only a significant difference between the Front and Gunner groups ($p = .046$). Figure 4 (top panel) shows that the Front SMEs mean responses were lower than those of the other two groups (with only the difference between Front and Gunner SMEs being significant). The ANOVA on the IED threat ratings revealed a significant difference between SME groups, $F(2,29) = 6.26$, $p < .05$. Post-hoc testing with Fisher's LSD test showed a significant difference between the Front and Rear groups ($p = .014$) and between the Gunner and Rear groups ($p = .002$). Figure 4 (bottom panel) shows that the Rear SMEs' threat ratings were higher than both the Front and Gunner SMEs'. While the ANOVAs did not establish significant differences consistently between all groups for both tests, the results of the first ANOVA suggest that the effect size was large and that it would have achieved significance had we had more participants.

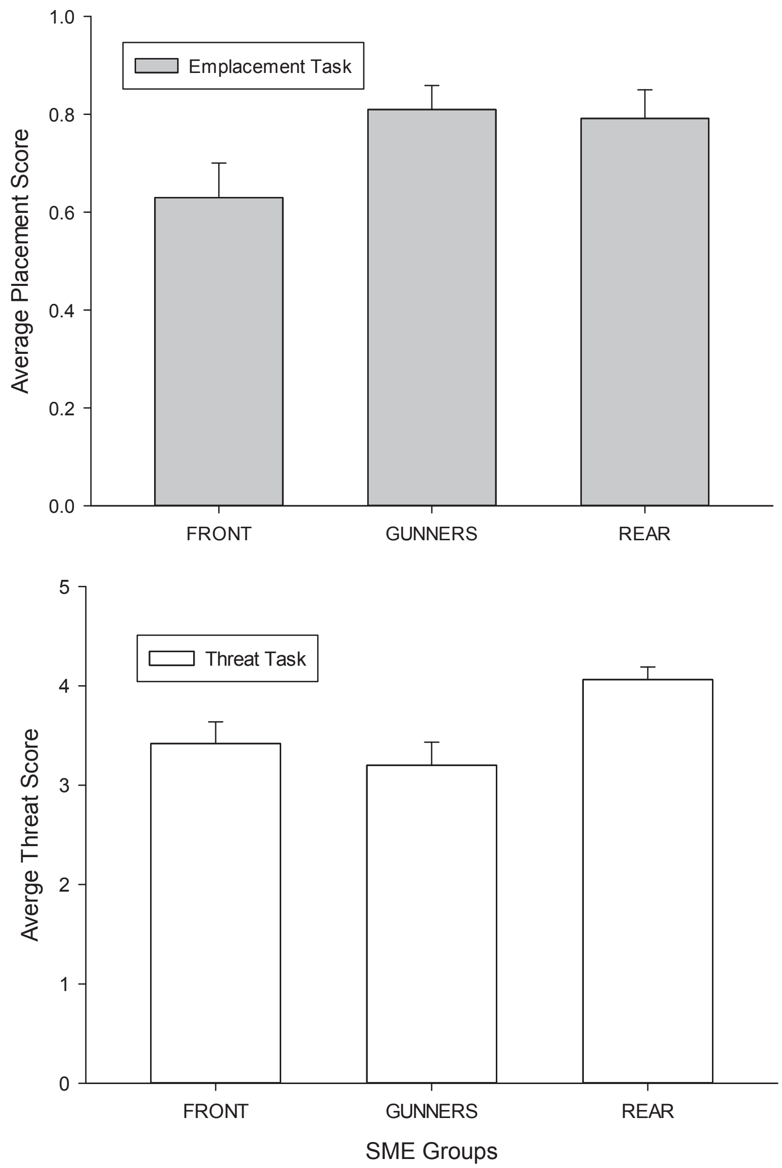

Figure 4: *Mean responses for different SME groups to the IED emplacement and IED Threat rating tasks.*

Intra-class correlations were then performed to determine whether each group provided internally consistent responses, which one would expect if each group reflects a consistent set of IED Awareness skills (or at least habits). Table 3 presents the intra-class correlations for each group for the IED emplacement and threat tasks. There is no definite answer how to treat the values of the intra-class correlations, but the literature suggests that values above 0.7 suggest that there is a good consistency among raters (Streiner, 2003). The intra-class correlations for the Front and

Rear SME groups were high (above 0.7, and often above 0.8), whereas the intra-class correlations for the Gunner SME group were lower than for the other two groups, and inconsistent (.363 for the IED emplacement ratings and .730 for the threat rating). The variability in the Gunners' responses echoes the variability seen in the group means above, where the Front SMEs' responses were always lower than the Rear SMEs', but the Gunners' responses alternated between being the highest for all groups for the IED emplacement judgments, and lowest for all groups for the IED threat ratings.

Table 2: *Intra-class correlations among SME groups in IED Emplacement and IED Threat tasks.*

Task	SME Group		
	Front	Gunners	Back
IED Emplacement	.744	.363	.723
IED Threat	.827	.730	.806

Together, the ANOVAs and the intra-class correlations suggest that the Front SMEs constitute a sub-population with different and reliable responses compared to the other two SME groups. Based on these results and our conceptual understanding of IED Awareness, we were therefore comfortable using the 11 Front SMEs' responses as the benchmark against which to analyze the experimental responses reported below. We also note that the variability in responses displayed by the Gunner group likely further justifies their exclusion of their responses from the experimental benchmark.

The selected SME responses were then checked for inter-item consistency. For example, if 50% of SMEs identified a video as a good IED emplacement location —responding at chance level—then such video cannot serve as either target or foil for analyzing the participants' responses. To eliminate these ambiguous videos, a 75% criterion was used (i.e., to be retained, the video clip had to be rated either as an IED emplacement site, or a "non-site," by at least 75% of the SMEs). While the set value of this criterion was arbitrary, it was useful in achieving a compromise between using only a highly consistent but very restricted response set, and a much broader but rather inconsistent response set. As a result of applying the 75% cut point, only two ambiguous videos were eliminated, leaving 12 videos consistently rated as either "targets" or "foils" by a majority of the selected SMEs, and subsequently used to analyze our participants' responses.

2.2.2 Short videos

2.2.2.1 IED emplacement task

To compare responses in the short video IED emplacement task, a Signal Detection Theory (SDT) framework was used to evaluate responses (for review see Green & Swets, 1966). SDT is often used to analyze responses to ambiguous stimuli, which can be classified into either a known process (i.e., the signal, which is usually a target stimulus) or obtained by chance (i.e., noise, which is usually a foil). The ability to discriminate between signal and noise is measured by the d-prime score, which represents the separation between the means of the signal and the noise distributions, in units of the standard deviation of the noise distribution. In other words, d-prime measures the degree of separation between the observer's internal representations of the signal and noise (i.e., the observer's ability to discriminate between signal and noise). As noted above, only responses from the 12 short test video clips that passed the 75% SME response criterion were analysed.

The paradigm is useful in the context of short video responses as they are categorical (targets versus foils, or in our case, the presence vs absence of an IED emplacement sites in a scene) and ambiguous. From the participants' yes/no responses, we computed the proportion of hits (videos that participants correctly identified a target relative to the SME's responses) and false alarms (videos that were identified as targets by participants and foils by SMEs) for the two Training groups and the control group in both the Pre- and Post-test. Note that for this analysis, as well as for all subsequent ones, no significant differences were found between the two Training groups; therefore, both Training groups were merged into a single experimental group, and data from both training groups were pooled, for this and all subsequent analyses.

Individual d-prime scores could not be calculated for those participants whose responses consisted of perfect scores for hits (100%). Instead, mean group hit and false alarm rates were computed and used to calculate d-prime values for each group and each training condition. The left panel of Figure 5 shows the average d-prime for both the experimental and control groups for both tests (pre- and post-). Overall, the d-prime values increased for the experimental groups, but remained unchanged for the control group. To evaluate whether the increase in d-prime for the experimental group was due to an increase in their hit rate or a reduction in their false alarm rate, a chi-square goodness-of-fit test was applied to see if the proportion of hits and false alarms was significantly changed from pre- to post-test. The gain in d-prime was due to reduced false alarm rates, $\chi^2(1, N = 60) = 12.58$, $p < .001$. For the experimental group, the hit rate remained constant (Pre-test: 83%; Post-test: 83%), whereas the false alarm rate decreased (Pre-test: 70%; Post-test: 60%). The control group's responses also did not change with respect to hit rate (Pre-test: 86%; Post-test: 85%) whereas the group's false alarm rate appeared to increase (Pre-test: 69%; Post-test: 75%).

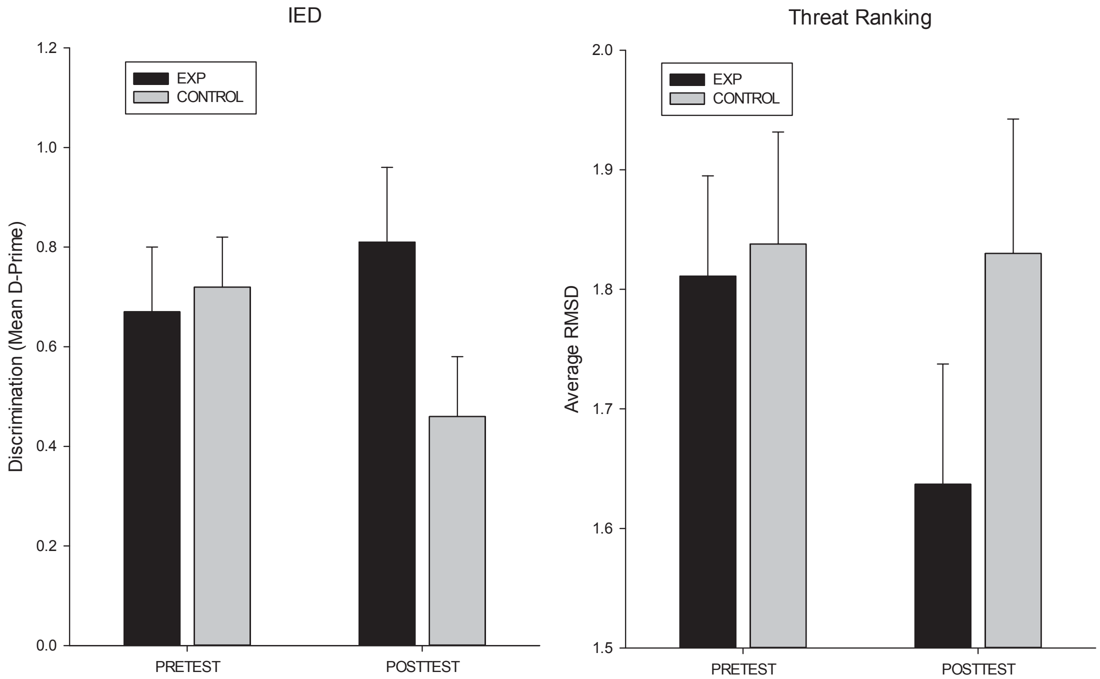

Figure 5: *Participants performance Pre- and Post-test in short video task.*

2.2.2.2 IED threat ratings

The responses in the IED threat rating task were compared using a root mean square deviation (RMSD) score. This measure is often used to evaluate a correspondence of two sets of data on a non-binary scale, such as the responses on our threat rating task, which were on a 1 to 5 scale (from Low to High Threat). The individual RMSD score was calculated for each participant as a measure of fit between that score and average threat score of the SMEs from the Front group. The RMSD results were compared by performing a mixed independent-repeated measures factorial ANOVA with the repeated measure being test position (two levels: pre- and post) and the independent measure being group type (Experimental vs Control). Both the main effect of group and the group×test interaction were significant, $F(1, 93) = 4.16$, $p < .05$ and $F(1, 93) = 3.93$, $p < .05$ respectively. The RMSD score by test and by group are shown in the right panel of Figure 5. The results show that the Experimental group's RMSD scores were lower (i.e., their threat ratings more closely matched the SME's ratings) than those of the control groups on both tests, but that the Experimental group's scores decreased (i.e., their threat ratings became closer to the SMEs') significantly after EFIT training, whereas the Control group's scores did not.

2.2.2.3 Discussion

The results from both short video tasks suggest the Experimental group's ratings improved, i.e., more closely matched the SMEs, after EFIT training, whereas the Control groups' failed to improve relative to SME responses. This was observed for both the IED emplacement and threat rating tasks. The IED emplacement task suggests that this improvement was mainly due to an improvement in the identification (i.e., rejection) of locations that are not conducive to IED emplacements, as indicated by the drop in false alarm rate. EFIT training did not improve the experimental group's ability to identify IED locations, relative to SMEs (which partially might be explained by a ceiling effect, considering that hit rate was often around 100%). Given that the participants in the study were at the end of their pre-deployment training cycle, it is perhaps not surprising that the hit rates for both groups were high right from the start and did not change on re-test. The results, however, show that the participants' false alarm rates were quite high, even with the improvement in the experimental groups. That is, the participants identified the vast majority of the short test videos as potential IED emplacement sites, even the ones discounted by experienced soldiers.

2.2.3 Long videos

The data from the long video task consisted of time-stamped episodes (i.e., a beginning and an end time) during which participants had held down the response button to indicate a good location for IED emplacement in the video they were watching. In order to evaluate how the participants' responses varied before and after training, the match between their responses and those of the SMEs were evaluated using RMSD score, which was calculated using individual timeline responses. As with the short videos task above, we only used the responses from the Front SME group. To obtain a set of analyzable values from these data, the timeline from each participant was partitioned into 1 sec intervals, where button-press episodes were coded as "1" and all other as "0". The SME responses were partitioned in the same way and then averaged to produce a "composite" reference response profile. Then the timeline from each individual was compared with the averaged SME timeline to obtain RMSD scores for each participant. The average score was calculated using this equation:

$$RMSD = \sqrt{\sum_{1}^{n} \frac{(i_{SME} - i_{SUB})^2}{n}} \qquad (1)$$

Where iSME is an average rating of SMEs for specific interval, iSUB is an average rating of participants for the same interval, and n is the interval length in seconds. The participants' RMSD scores were then submitted to a mixed between-within-factor ANOVA. The between-subject factor was group (Experimental-Control) and the two within-subject factors were video (1-3) and training (pre- and post-training performance). The effect of groups was significant, $F(1, 165) = 5.53$, $p < .05$ and so was the effect of training, $F(1, 165) = 6.11$, $p < .05$. The interaction between training and groups was also significant too, $F(2, 165) = 4.49$, $p < .05$. Video position had no effect on RMSD scores, suggesting that the content of the videos had no influence on how closely participants' responses matched those of the SMEs. Figure 6 shows participants' RMSD scores by group and test session, averaged over the 3 videos. As the figure shows, the participants in the experimental group improved their fit with the SMEs' responses. The control group's responses, however, further diverged from the SMEs' in the second session.

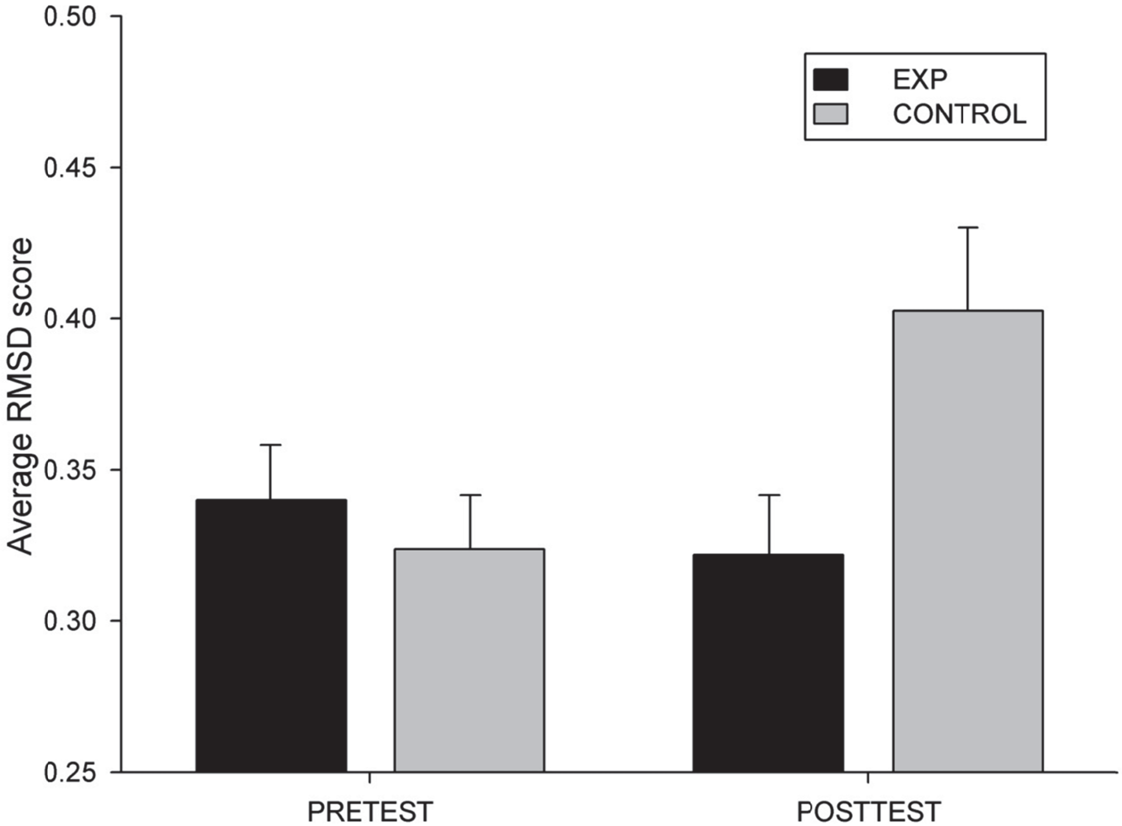

Figure 6: *Participants performance Pre- and Post-test in long video task.*

2.2.4 Demographics and feedback

In the context of this work, the demographic details of the participants were used for the purpose of selecting pool of SMEs. Further demographic details were served to re-fine the most appropriate category of SMEs best suited to benchmark responses of non-SME participants (see 2.2.1)

A feedback questionnaire was used to evaluate participants' subjective impressions of the EFIT-based training (see Annex A.6 for the feedback questions). All questionnaire items but one ("Have you learned something new") were scored on a 5-point scales ranging from 1 ("not useful at all") to 5 ("extremely useful"). The majority of participants (55%) replied that they learned something new participating in EFIT training. Table 2 shows the list of the questions ranked by their average value. According to participants, the most beneficial features of the EFIT training were related to becoming familiar with the terrain in theatre and helping to identify IED indicators.

__Table 3:__ Average feedback questionnaire item ratings, ordered from highest to lowest.

Question	Average Score
Becoming familiar with the terrain in theatre	3.76
Identifying IED indicators	3.52
Training for scanning the terrain	3.48
Determining the threat level (threat assessment)	3.00
Becoming familiar with routes	2.93
Becoming familiar with the cultural environment (what's normal in theatre)	2.85
Becoming familiar with convoy operations	1.97

Figure 7 shows the mean scores for the feedback questions for the two groups. Overall, the responses were not statistically different with exception of "Identifying IED indicators" and "Have you learned something new" questions, $t(153) = 2.86$, $p < .05$ and $t(153) = 3.58$, $p < .05$ accordingly; the mean values for the latter question were 2.76 and 1.42 for Experimental and Control groups.

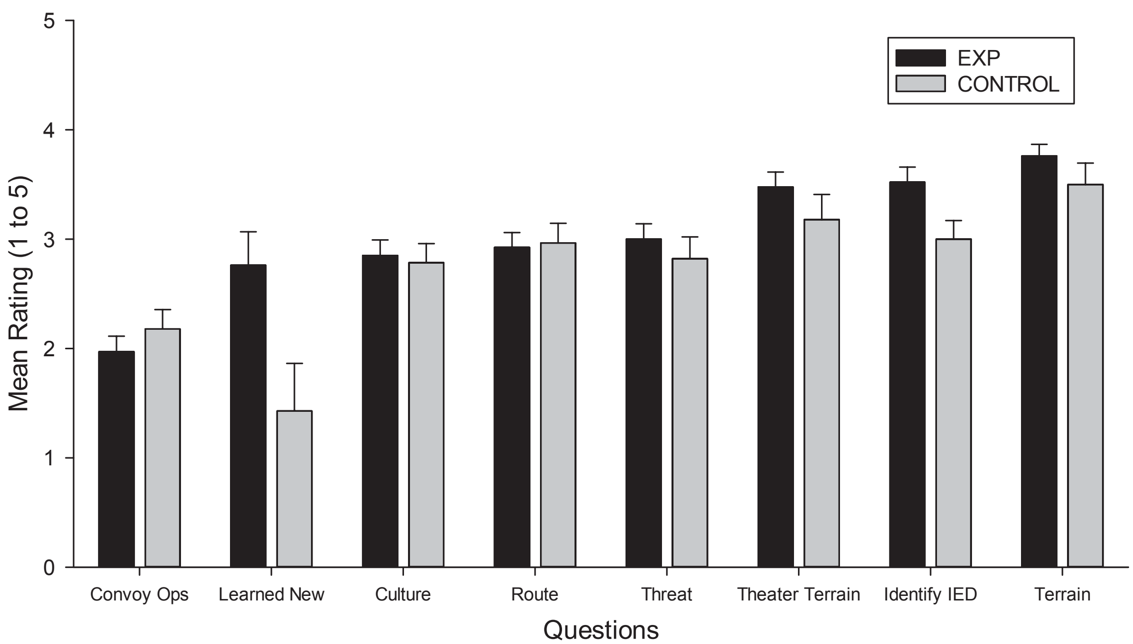

***Figure 7:** Participants ranking of feedback scores. Note that the "Learned New" means have been scaled to fit the range of the other responses (i.e., a 100% rating corresponds to a score of 5 in the figure).*

It is difficult to determine what underlies the differences between the two groups' subjective ratings, particularly on the question about whether they learned anything new. It could be that, due to the unusual sequence of tasks that the control group was presented with (pre-test, post-test, then EFIT training; see Table 1) the purpose of the training intervention itself confused them, and diminished its value in their eyes. It is also possible that, because the decision to expose the control group to EFIT training was made by their Commanding Officer at the last minute, only after he observed the experimental groups undergoing EFIT training, the control group's EFIT session was seen as an arbitrary imposition, and resented. In any event, we cannot determine whether the control group's subjecting impression of having learned anything corresponds to any changes in IED Awareness skills due to EFIT training, as we did not test their performance post-EFIT. Neither can we determine how well the experimental group's subjective impression of having learned something new corresponds to the objective improvements we observed in the video test tasks.

The feedback questionnaire contained a free text question that asked participants their opinion of the EFIT training tool. Below are some positive comments provided by participants in the free-text question. Consistent with the mean scores, the tool was generally judged as helpful, with some comments also suggesting that the conventional TMST training and EFIT training could complement each other:

"*We have been training for overseas deployment and have studied many of the things in this presentation so I found it added to my knowledge base. Had I not been on deployment training and just did this work without the knowledge I have, I think I would not have grasped as much as I did today."*

"The maps and stuff like that of previous sites of ied bombs [sic] were helpful"

"This tool should be used for anyone going overseas"

"Overall, this was (and looks like it will continue to be) a great IED familiarization training program"

"Great for trying to spot possible positions for IED as well as showing how crowed [sic] the city can be and how alert you have to be in order to save yours and your buddies [sic] life".

Some negative comments were also expressed; many of them were related to a repetitive character of the pre- and post-testing (e.g., a repeated use of the same videos), a monotonic voice of the SME narrator, and unsuitability of the training to the advanced stages of training that many participants were in. Among suggestions to improve the tool were related to providing the tool at the early stages of pre-deployment training, using higher-resolution videos, and including real videos of IED explosions in theatre.

Note that, despite the perception of some participants that EFIT training wasn't advanced enough, and the relatively low overall endorsement of having learned something new (not much higher than 50%), the video test task measures clearly indicated an improvement in IED Awareness judgement after EFIT training. This shows that it is difficult to assess real training impact of an intervention from subjective ratings alone.

3 General Discussion

3.1 Effectiveness of EFIT

We presented a study where soldiers with no operational experience with IEDs but with TMST performed two IED Awareness test tasks; one group performed the two tasks, then underwent IED Awareness training with EFIT, then performed the two test tasks again. Another group also performed the 2 test tasks, but without the benefit of EFIT training in between the test sessions.

Results showed that the group receiving EFIT improved their performance, that is, their responses resembled those of SMEs more closely after EFIT training. The group that did not receive EFIT before they were not re-tested did not improve, suggesting the improvements come from EFIT, not re-testing. This suggests EFIT improves IED Awareness skills. Also suggests EFIT teaches something not available in typical, declarative knowledge-based classroom CIED instruction, and therefore that EFIT can complement such “traditional” training. Finally this suggests that EFIT, or other similar video-based perceptual training can be used to transfer the more-or-less tacit knowledge developed by SMEs from their experiences with CIED operations in theatre.

3.2 Study limitations

A number of limitations must be considered in interpreting the findings of the study. First is a possible group effect. For administrative reasons, participants were assigned to either experimental group or the control group in blocks. That is, participants joined the experiment as platoons (roughly 30 soldiers), and whole platoons were assigned to a specific condition. Soldiers also undergo their pre-deployment training grouped by platoons. Thus, at this point we cannot rule out that their differential performance in the experimental tasks reflects some difference(s) in how each platoon was trained, or how each platoon responded to training, based on group dynamics. However, the fact that both experimental groups improved their performance (and were therefore pooled in the analysis) suggests that the improvements, at least, weren’t due to particular group effects.

A second limitation is that it is unclear what effects testing participants twice with identical materials, in and of itself, might have had on test performance. For the control group, performing the same test twice, with no intervening training or experimental task, might have been boring, or might have strained vigilance. Indeed, according to vigilance studies, participants become less vigilant in longer tasks that have low frequency of signals for which they are searching (Craig, 1978; Davies & Parasuraman, 1982; for recent results in the context of theater-related tasks see Hancock & Hart, 2002). Thus, the apparent decrement in performance in the second test for the control group, and the relative improvement in the experimental groups, might be related to reduced vigilance for the control group. By extension, this could suggest that the effects of EFIT training might have been mitigated by a vigilance decrement in the experimental group. Conversely, it might be that EFIT training has its effect by counteracting a vigilance decrement, at least in part. As Szalma et al. (1998) showed, a feedback in the form of providing participants with knowledge results enhanced their sensitivity to signals in a vigilance task. It is possible that EFIT training was acting in the same way as knowledge results feedback in the Szalma et al. study. One way to examine this issue experimentally would be to evaluate the SMEs responses in both Pre- and Post-test sessions, to determine whether expertise, without an intervening activity session acting as a diversion, would counteract the likely vigilance decrement of a second testing session.

A third limitation of the study concerns the source of the effectiveness of EFIT. As described above, EFIT consists of video of real operational terrain supplemented by instructor voice over. Some EFIT videos are supplemented by a moving map, and show continuously evolving terrain as the vehicle moves down the road, thus showing participants many instances (or counter-examples) of possible IED emplacements, without showing any twice. Other EFIT videos omitted the moving map in favour of focusing on a handful of instances of a type of IED emplacement and showing them repeatedly, in order to "drill in" what certain "typical" IED emplacement patterns look like. All of these might have contributed to some degree to the overall effect of EFIT on the performance of the Experimental group. But due to the design of the study, we cannot determine which aspects of EFIT were responsible for the majority of the effect. Administrative issues (time, limited access to participants) prevented us from running additional conditions where specific aspects of EFIT could have been contrasted against one another to determine the source of EFIT's efficacy. However, it would be desirable to examine this issue, in order to determine the "minimum features" required to make EFIT effective, or which aspects might interfere with EFIT's effectiveness.

Another limitation resides in using SME data as a normative reference. Two issues arise here: first, low statistical power prevent us from being able to definitively detect significant differences between the SME groups we identified earlier. The nearly-significant results we observed, along with our theoretical model of IED Awareness and the intra-class correlations, gave us enough grounds to pick the Front group as the reference group. However, it would have been preferable to have obtained a significant difference between all SME groups for the test tasks. The second limitation involves the reason we relied on SME responses in the first place, that is, the lack of a normative standard for IED Awareness or IED detection performance in general. While the use of SMEs mitigates this somewhat, it also relies on the assumption that the SMEs we picked on theoretical grounds were in fact the "best" as detecting IEDs, something for which we do not have hard empirical evidence. In fact, obtaining empirical evidence for this would be very difficult, and would involve either collecting data in the dangerous and complex conditions of the theatre of operations, or constructing a contrived but nevertheless realistic "enough" physical simulation of an operational environment (a so-called "IED lane"), which would itself have to be validated. That said, we know from other sources that SMEs do develop visual scanning skills in IED environments that novices do not possess (Jarmasz, 2010; Murphy, 2010; Zotov, Keillor & Jarmasz, 2010). Furthermore, the fact that the SMEs with the most experience with visual scanning the environment for threat from a rolling vehicle (the Front and Gunner groups) had performance that differed markedly from the experimental participants, whereas the SME group with the least experience with visual scanning from vehicles (the "Rear") group most resembled the experimental participants, suggests that the video tests we developed did in fact tap into whatever visual scanning skills that some SMEs developed overseas. In that sense, the SME data are like those from a reverse transfer-of-training study, where experts' and novices' performance are compared in a simulated training task, and where, if the training environment is valid, experts will demonstrate high performance much more quickly than will the novices. These considerations suggest that the video tests and EFIT training we devised do actually capture a skill that SMEs developed while searching for IEDs in the field, and for now, this is the best stand-in we have for measuring actual IED search and recognition skills.

3.3 EFIT & perceptual learning

3.3.1 General skills / PLMs

Our study showed that participants were able to better distinguish targets (likely IED emplacements) from foils (unlikely IED emplacements) using purposely designed video materials which exposed learners to many instances of both targets and foils. This is consistent with other research on using perceptual learning techniques, or "perceptual learning modules," to train recognition and detection skills (e.g., Guerlain et al., 2004; Schuster, Rivera, Sellers, Fiore & Jentsch, 2010). One difference between our study and others was the use of naturalistic video (rather than static naturalistic images or synthetic video) to train, as well as to test, participants. This expands the generalizability of findings in this area to a wider range of training materials.

It should be noted that recent work on training airport baggage screeners (x-ray) suggests that different types of training may differentially affect the development of identifying targets versus rejecting false alarms in detection tasks (Schuster et al., 2010). That is, exposure training, which exposes trainees to stimuli which either contain or don't contain targets, and asks trainees to merely detect whether the target is present, seems to specifically improve trainees' ability to reject stimuli where the target is absent (false alarm), without significantly affecting their ability to correctly recognize when the target is present (a hit). However, discrimination training, which presents trainees with pairs of stimuli, one of which is a target, and the other of which is either the same target in a different orientation, or a foil stimulus designed to look similar to the target, and where the participants' task is to determine whether the two stimuli are the same or not, seems to result in an improvement in trainees' ability to correctly recognize targets (in this case, inappropriate items in baggage x-rays), that is, it improves their hit rates, in subsequent target detection tests. While it is not clear whether these results obtained with baggage x-ray stimuli can generalize to the more dynamic and ambiguous stimuli encountered in IED detection, it is of note that the EFIT training approach resembles more closely the exposure training method than the discrimination training method studied by Schuster et al. (2010). And, as noted above, training with EFIT preferentially improved false alarm rates rather than hit rates, consistent with Schuster et al.'s findings on exposure training. Thus, adapting EFIT to support discrimination training, perhaps by showing closely similar scenes that nevertheless have very different IED emplacement potential and threat levels (as determined by SMEs), might improve soldiers' ability to correctly identify higher IED threat situations than the current implementation of EFIT. In fact, the video materials we used for EFIT would already support this type of training, as they contain a variety of potential IED emplacement scenes with varying degrees of "goodness" (as emplacement sites) and a variety of potential threat indicators (suggesting varying threat levels). Using these to promote discrimination training would then involve requiring trainees to compare different IED emplacement scenes and assess their relative IED emplacement suitability or threat levels, rather than simply judging individual scenes.

Another more specific question that this study tried to answer was related to the effectiveness of EFIT-training with soldiers undergoing pre-deployment training, in particular soldiers participating in a field exercise. The stresses of a field exercise might interfere with learning from EFIT, whereas the motivation and learning skills that help one to cope with and survive a dangerous deployment might enhance learning. One way to test effectiveness of training is to compare physiological responses of soldiers after they received video-based training. As Zotov et al. (2009); Zotov, Keillor & Jarmasz, (2011) showed, SMEs with recent deployment experience showed distinct eye-tracking patterns while observing dangerous environment. Thus, if there is a link between training effectiveness and level of stress, such knowledge can be used as an additional diagnostic tool that evaluates the effectiveness of training.

3.3.2 Perceptual learning for military training

Returning to the context of training skills for military operations, it is noteworthy that EFIT training was provided to soldiers who had just recently completed their mission-specific training for an IED threat environment, and that the training we provided actually shifted their IED emplacement and threat discrimination abilities closer to those of experienced soldiers. This suggests obviously, that EFIT can be a complement to the "standard", classroom- and field-exercise-based training that soldiers receive during TMST. An implication of this is that some operationally-relevant perceptual learning is not optimally supported by the "standard" TMST training. As mentioned in Guerlain et al. (2004), institutional training does not always support the learning and training of perceptually-based skills, due to reliance on text-and-static-image-based classroom training, favoured due to pressures to put as many people through training as quickly as possible. The pressures to train as many people as possible in a short time are real, especially during high-tempo operations, and simple tools such as video-based trainers like EFIT could easily be used to fill some of the gaps in perceptual learning created by these pressures.

It should also be noted that EFIT was well received. The participants in our study gave EFIT generally favourable ratings, as discussed above, in addition to suggesting areas for improvement. This is consistent with informal feedback we have received from other users, as well as end-user impressions we gathered during a usability study of EFIT (Lamb, Mach, Jarmasz & Wojtarowicz, 2013). Thus, as a training tool for military skills, EFIT is effective at the two first levels of Kirkpatrick's four-level model of training evaluation (Kirkpatrick & Kirkpatrick, 2006), i.e., "Reaction" and "Learning". To do a full evaluation of EFIT's effectiveness, according to Kirkpatrick's model, would require evaluation at the "Behaviour" (i.e., transfer-of-training) and "Results" (organizational effectiveness or impact) levels. Unfortunately, evaluation at those levels were beyond the scope of this project. However, informal feedback from deployed units indicates that some soldiers who were exposed to EFIT training subjectively felt it helped them perform their jobs in theatre. While encouraging, it would be good to assess this contention empirically.

The perceptual patterns involved in IED Awareness change rapidly, since the threat itself adapts rapidly to counter-IED measures (Eles, 2009), and soldiers in theatre (or about to be deployed) could benefit greatly from receiving the latest operational experiences or "lessons learned" from other deployed soldiers. Our study has shown that a tool like EFIT can be used not only to impart PLM-based training as discussed above, but also "lessons learned" from previously deployed soldiers, as demonstrated by the fact that the participants were able to more closely match the performance of SMEs after EFIT training. Thus, EFIT can be thought of as a "lessons learned" vehicle as well as a perceptual skills training tool.

The tools and materials required for producing EFIT videos (some high-definition ruggedized cameras, synchronized GPS data sensors, and commercial software already available throughout DND) are simple and affordable. Thus, producing EFIT videos is fairly easy and can be done with a rapid turn-around. The biggest "obstacles" to producing EFIT videos are the data collection itself (mainly in terms of ensuring the data collection does not interfere with operational logistics and security) and the Instructional Design aspects of producing an actual training video from the raw footage obtained in theatre. These Instructional Design aspects include selection of relevant video from the hours of video that would have to be captured for such an effort, and generating and producing the teaching points (both verbal SME commentary and visual highlights on the video) that augment the video in EFIT. Both of these points can be effectively addressed by having SMEs with operational experience and SMEs with instructional design experience working together. The production of training materials from raw video captured in theatre can also be supported by adequately tagging segments of video of interest by SMEs before courseware designers are provided with the video; this will ensure that the designers of the instructional material can easily and quickly select relevant video clips to use to support specific teaching points. Such a video annotation tool, the DRDC Video Processor, was developed by the project team for the eventual production of EFIT videos, and can be easily made available to anyone within the Department of National Defence. With tools such as the DRDC Video Processor and the expansion of courseware development cells in the CAF training community (e.g., the Army Learning Support Centre at Combat Training Centre Gagetown), the collaborations required for producing effective EFIT-like training materials should be readily feasible, and in times of war, should be able to provide up-tempo updates to learning materials. Once produced, EFIT videos can be easily disseminated to a wide audience in a variety of media formats (CDs, DVDs, USB sticks, via inter/intranet) and a variety of contexts (classroom, take-home leaning, distance learning, field exercise, within theatre). Thus, the potential for imparting IED Awareness skills and Counter-IED lessons learned with EFIT or similar products is huge.

Finally, as discussed above, the Perceptual learning module approach is applicable in a wide range of domains. Therefore, the general approach illustrated with EFIT here can and should be used for any other visual search/hazard awareness/familiarization training that the CAF require, especially for threats or materials of interest that are rich, complex, ambiguous, and difficult to reproduce accurately in large quantities in the classroom or the field, such as patterns of civilian life, cultural features, ambush attack patterns, and so on. As noted above, such video-based tools using real video from operational theatres can also support the rapid and comprehensive transmission of operational “lessons learned” from deployed soldiers. The technological investment in such training materials would be relatively low, especially considering the ease with which they could be widely disseminated. They main challenge in developing such materials would be in applying a combination of sound instructional design techniques with recent and relevant “lessons learned” from experienced soldiers, both of which are readily available in the CAF and which only require institutional facilitation and support to become a success.

References

Bryun Martin, L., & Karthaus, C. (2009). Cognitive Task Analysis of Improvised Explosive Device Detection and Assessment in CF Convoy Operations. DRDC Contract Report CR2009-176. Human Systems Incorporated.

Chief of Defence Staff (2008). CDS Supplemental Directive – Enhancement of CF C-IED Capabilities in Afghanistan. Department of National Defence, Ottawa.

Craig, A. (1978). Is the vigilance decrement simply a response toward probability matching? Human Factors, 20, 441–446.

Davies, D. R., & Parasuraman, R. (1982). The Psychology of Vigilance. London: Academic Press.

Department of National Defence (2006). Canadian Forces Counter Improvised Explosive Device (IED) Tactics, Techniques and Procedures Handbook. Ottawa.

Eles, P., (2009, July). Characterizing the IED threat: A classification of IED events in Kandahar Province (Initial Results). Unclassified presentation developed by Defence Research & Development Canada Centre for Operational Research and Analysis (CORA), presented at Defence Research and Development Canada, Toronto, ON.

Gibson, J. J. (1979). The Ecological Approach to Visual Perception. Boston: Houghton Mifflin.

Green D.M., & Swets, J.A. (1966). Signal detection theory and psychophysics. New York Wiley.

Guerlain, S., Green, K., LaFollette, M., Mersch, T., Mitchell, B., Pool, G., Callan, J., Lv, Jianhong, L., & Chekan, E.G. (2004). Improving Surgical Pattern Recognition through Repetitive Viewing of Video Clips. IEEE Transactions on Systems, Man, and Cybernetics, 34(6):699-707.

Hancock, P. A., & Hart, S. G. (2002). Defeating terrorism: What can human factors/ergonomics offer? Ergonomics in Design, 10, 6–16.

Jarmasz, J. (2010). Summary of findings on visual scanning and assessment of IED threats by soldiers in operational environments. Technical Memorandum, TM 2010-197, DRDC-Toronto.

Keillor, J., Jarmasz, J., Pavlovic, N., & Lamb, M. Visual search as a real-world task: Effects of expertise on scanning, Perception, 36 ECVP Abstract Supplement, 2007.

Kirkpatrick, D. L., & Kirkpatrick, J. D. (2006). Evaluating Training Programs: The Four Levels. San Francisco: Berrett-Koehler.

Kellman & Garrigan (2009). Perceptual learning and human expertise. Physics of Life Reviews, 6: 53–84.

Lamb, M., Mach, P., Jarmasz, J., & Wojtarowicz, D. (2013). Interactive environment familiarization and indicator trainer. DRDC Toronto report TN 2012-081.

McDermott, K., Mulligan, J., Bebis, G., & Webster, M. (2006). Visual search and eye movements in novel and familiar contexts. SPIE-IS&T 60570C-1.

Murphy, J. (Ed.) (2010). "Identifying Experts in the Detection of Improvised Explosive Devices (IED2)". Technical Report, Arlington, VA, TR 1269.

Schuster, D., Rivera, J., Sellers, B., Fiore, S.M., & Jentsch, F. (2010). Individually Adaptive Discrimination Training for Improvised Explosive Detection. Proceedings of the Human Factors and Ergonomics Society Annual Meeting. September 27 – October 1, 2010, San Francisco, California, 54, 2253-2256.

Streiner, D. L. (2003). Being inconsistent about consistency: When coefficient alpha does and doesn't matter. Journal of Personality Assessment, 80(3), 217-222.

Szalma, Teo, Hancock, & Murphy. (2011). "Implications for Vigilance Training to Support Improvised Explosive Device Detection." Proceedings of the Human Factors and Ergonomics Society Annual Meeting. 19-23 September, Las Vegas, Nevada, 55 1548-1551.

Zorpette, G. (September 2008). Countering IEDs. IEEE Spectrum, 27-35.

Zotov, V., Keillor, J. M., & Jarmasz, J. (2011). Measuring "Spidey Sense" in a Threat Detection Task: The Role of Physiological Arousal. Proceedings of the Human Factors and Ergonomics Society Annual Meeting. 19-23 September, Las Vegas, Nevada, 55, 1265-1269.

Zotov, V., Keillor, J., Scourtoudis, E., Chen, M., Jarmasz, J., & Boyne, S. Effects of Experience on a Threat Detection Task. Presented at the 49th Annual Meeting of the Society for Psychophysiological Research, Berlin, Germany, 2009, Abstract in Psychophysiology, Vol. 46, p. 121.

Annex A Instructions

A.1 Demographics

Participant #		Age:	
Rank:		Years in Military:	
Sex:	M F	Unit:	
Trade:			
Current Position:			
What tours have you completed? For each tour, list location, year and your position. If you were in a vehicle crew, indicate your positions.			
What C-IED training have you received in this pre-deployment cycle. (e.g., classroom briefing, IED petting zoo, practical training).			
What other C-IED training have you received prior to this cycle, if any.			
Have you seen the Environment Familiarization and Indicator Trainer (EFIT) before? If so where?			

A.2 Long video instructions

Test Phase: Part 1

You will watch three brief videos (approx. 10 minutes) depicting Afghanistan terrain from the viewpoint of someone travelling in a CF convoy. As you watch the videos, please press and hold the spacebar for as long as you feel the vehicle is at or next to a good IED emplacement site. Press okay if you understand the instructions or ask the experimenter if you need clarification.

A.3 Short video instructions

You will now view a series of short clips. After each clip, fill out a form provided. The form will ask you to

- -determine whether the video contained a good IED emplacement site
- -choose the type(s) of IED, if any, you would expect
- -rate the IED attack threat level at this time in the video
- -explain your ratings

Some of the clips you will now see have been taken from the longer ones you viewed in the first part of the test. Please avoid basing your answers on any information you might remember from the earlier videos that does not appear in the short clips that follow.

A.4 Short video questions

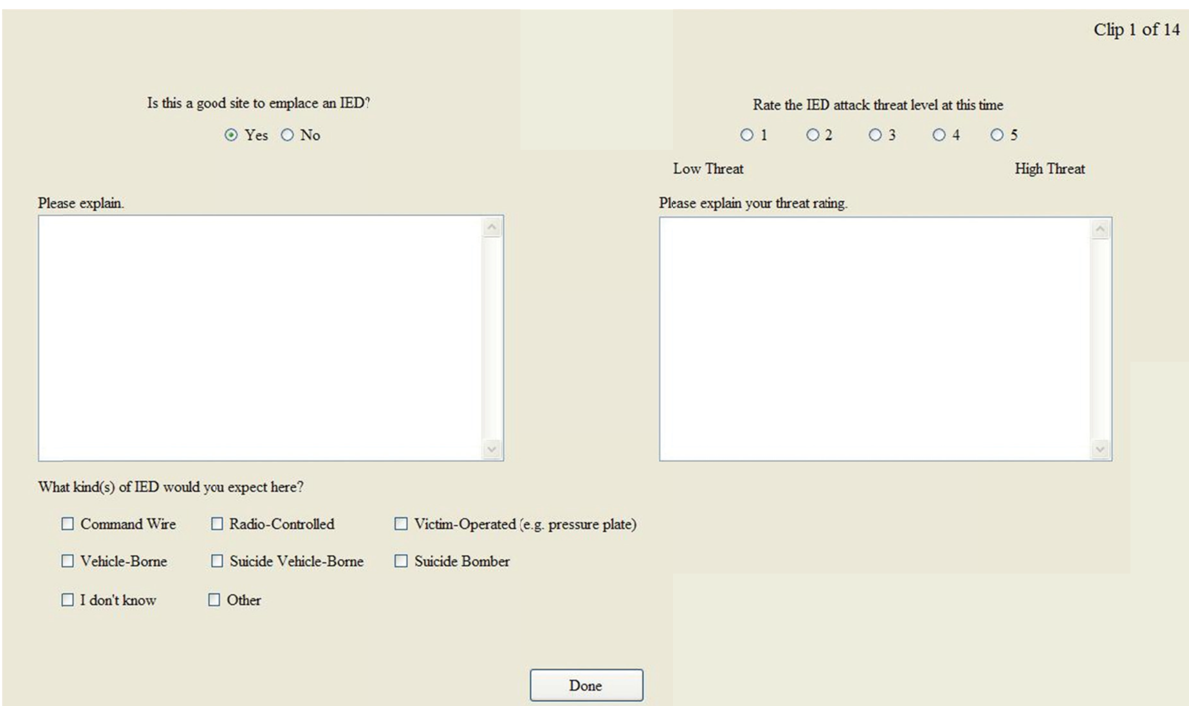

Figure A.1: *A pop-up instruction given prior to starting a short video test.*

A.5 Post-test questionnaires

Participant #			
Were the displays in the test easy to see?		YES	NO
Were the instructions for the test easy to understand?		YES	NO
Did you use the map shown next to the video in Part 1 of the test?		YES	NO
	When and what for?		
Do you remember travelling on any of the routes shown in the videos you saw today?		YES	NO
	Please specify which routes you travelled and how often:		
Additional Comments:			

A.6 Training video feedback questionnaires

Participant #			

Please rate the usefulness of this training tool.

(1 = not useful at all; 5 = extremely useful)

1	2	3	4	5	Becoming familiar with routes
1	2	3	4	5	Becoming familiar with the terrain in theatre
1	2	3	4	5	Becoming familiar with the cultural environment (what's normal in theatre)
1	2	3	4	5	Identifying IED indicators
1	2	3	4	5	Determining the threat level (threat assessment)
1	2	3	4	5	Becoming familiar with convoy operations
1	2	3	4	5	Training for scanning the terrain

Did you learn anything new during the video training today?	YES	NO

Please describe what you learned:

List of symbols/abbreviations/acronyms/initialisms

ANOVA	ANalysis Of VAriance
CAF	Canadian Armed Forces
CFB	Canadian Forces Base
CIED	Counter-Improvised Explosive Device
CORA	Centre for Operations Research and Analysis
DND	Department of National Defence
DRDC	Defence Research & Development Canada
DRDKIM	Director Research and Development Knowledge and Information Management
EFIT	Environment Familiarization and Indicator Trainer
IED	Improvised Explosive Device
ISAF	International Security Assistance Force
LAV	Light Armoured Vehicle
LSD	Least Significant Difference
NATO	North Atlantic Treaty Organization
PLM	Perceptual Learning Module
R&D	Research & Development
RMSD	Root Mean Square Deviation
RMSE	Root Mean Squared Error
SDT	Signal Detection Theory
SME	Subject Matter Expert
TDP	Technology Demonstration Program
TF	Task Force
TMST	Theatre Mission-Specific Training
TTPs	Tactics Techniques and Procedures

This page intentionally left blank.

DOCUMENT CONTROL DATA

(Security markings for the title, abstract and indexing annotation must be entered when the document is Classified or Designated)

1. ORIGINATOR (The name and address of the organization preparing the document. Organizations for whom the document was prepared, e.g., Centre sponsoring a contractor's report, or tasking agency, are entered in Section 8.) Defence Research and Development Canada – Toronto 1133 Sheppard Avenue West P.O. Box 2000 Toronto, Ontario M3M 3B9	2a. SECURITY MARKING (Overall security marking of the document including special supplemental markings if applicable.) UNCLASSIFIED 2b. CONTROLLED GOODS (NON-CONTROLLED GOODS) DMC A REVIEW: GCEC DECEMBER 2012

3. TITLE (The complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S, C or U) in parentheses after the title.)

Improving perceptual judgement for recognizing improvised explosive threats : Assessment of the effectiveness of the environment familiarization and indicator trainer

4. AUTHORS (last name, followed by initials – ranks, titles, etc., not to be used)

Zotov, V.; Jarmasz, J.; Lamb, M.; Wojtarowicz, D.

5. DATE OF PUBLICATION (Month and year of publication of document.)	6a. NO. OF PAGES (Total containing information, including Annexes, Appendices, etc.)	6b. NO. OF REFS (Total cited in document.)
October 2014	46	23

7. DESCRIPTIVE NOTES (The category of the document, e.g., technical report, technical note or memorandum. If appropriate, enter the type of report, e.g., interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered.)

Scientific Report

8. SPONSORING ACTIVITY (The name of the department project office or laboratory sponsoring the research and development – include address.)

Defence Research and Development Canada – Toronto
1133 Sheppard Avenue West
P.O. Box 2000
Toronto, Ontario M3M 3B9

9a. PROJECT OR GRANT NO. (If appropriate, the applicable research and development project or grant number under which the document was written. Please specify whether project or grant.)	9b. CONTRACT NO. (If appropriate, the applicable number under which the document was written.)
	12rr03

10a. ORIGINATOR'S DOCUMENT NUMBER (The official document number by which the document is identified by the originating activity. This number must be unique to this document.)	10b. OTHER DOCUMENT NO(s). (Any other numbers which may be assigned this document either by the originator or by the sponsor.)
DRDC Toronto TR 2013-155	

11. DOCUMENT AVAILABILITY (Any limitations on further dissemination of the document, other than those imposed by security classification.)

Unlimited

12. DOCUMENT ANNOUNCEMENT (Any limitation to the bibliographic announcement of this document. This will normally correspond to the Document Availability (11). However, where further distribution (beyond the audience specified in (11) is possible, a wider announcement audience may be selected.))

Unlimited

13. ABSTRACT (A brief and factual summary of the document. It may also appear elsewhere in the body of the document itself. It is highly desirable that the abstract of classified documents be unclassified. Each paragraph of the abstract shall begin with an indication of the security classification of the information in the paragraph (unless the document itself is unclassified) represented as (S), (C), (R), or (U). It is not necessary to include here abstracts in both official languages unless the text is bilingual.)

Improvised Explosive Devices (IEDs) pose a significant threat to the safety of Canadian Armed Forces (CAF) personnel currently deployed in overseas missions. Anecdotal evidence indicates that experienced convoy crews develop an intuitive sense of potential IED threats in unfamiliar terrain. The Environment Familiarization and Indicator Trainer (EFIT) is a tool developed by DRDC Toronto in an attempt to train this intuitive IED detection capability. EFIT provides cultural familiarization of the operational terrain by exposing troops to real video of convoy operations integrated with current high-resolution satellite imagery and vector data. A study was conducted to evaluate EFIT's effectiveness as a training tool for recognizing and detecting indicators of IED threat in a realistic environment. Participants were asked to perform two separate, video-based threat perceptual/judgment tasks, and their responses were compared to those of CAF troops with previous operational experience with IEDs in Afghanistan, in order to determine whether EFIT training improved their baseline IED threat assessment skills. Participants who trained with EFIT improved in their ability to distinguish between lower and higher IED threat situations (as determined by a panel of experts), relative to participants who did not receive the training. Feedback from the participants showed that they gained a better understanding of the specific IED indicators and the general contextual clues of IED-related threats. This study indicates that training with EFIT can augment the mission-specific C-IED training already provided by the CAF.

Les engins explosifs improvisés (EEI) constituent une menace importante pour la sécurité du personnel des Forces armées canadiennes (FAC) actuellement déployé dans le cadre de missions à l'étranger. Des preuves anecdotiques indiquent que les équipages de convoi chevronnés développent une certaine intuition en ce qui concerne les menaces potentielles d'EEI en terrain inconnu. Le Simulateur d'indices et de familiarisation avec l'environnement (SIFE) est un outil développé par RDDC Toronto dans le but d'entraîner cette capacité intuitive de détection des EEI. Le SIFE permet de familiariser les militaires avec le terrain opérationnel en exposant ceux-ci à des vidéos réelles des opérations de convois intégrées à une imagerie satellite à haute résolution et à des données vectorielles. On a réalisé une étude afin d'évaluer l'efficacité du SIFE comme outil d'entraînement permettant de reconnaître et de détecter les indicateurs de menace d'EEI dans un contexte réaliste. On a demandé aux participants d'effectuer deux tâches distinctes de perception et de jugement de la menace par vidéo, et leurs réponses ont été comparées à celles des troupes des FAC ayant une expérience opérationnelle antérieure des EEI en Afghanistan, afin de déterminer si l'entraînement au SIFE améliorait les compétences de base en matière de détection de la menace des EEI. Les participants qui s'étaient entraînés avec le SIFE avaient amélioré leur capacité à faire la distinction entre les situations de menace d'EEI élevées et faibles (selon ce qu'a déterminé un panel d'experts), par rapport aux participants qui n'ont pas reçu l'entraînement. La rétroaction des participants a laissé entendre qu'ils avaient une meilleure compréhension des indicateurs d'EEI spécifiques et des indices contextuels généraux des menaces liées aux EEI. La présente étude montre que l'entraînement au SIFE peut renforcer l'instruction C EEI propre à la mission qui est déjà donnée par les FAC.

14. KEYWORDS, DESCRIPTORS or IDENTIFIERS (Technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location may also be included. If possible keywords should be selected from a published thesaurus, e.g., Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus identified. If it is not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title.)

IEDs, Improvised Explosive Devices, EFIT, Training, Video, Situation Awareness,

Perceptual Learning Modules, Afghanistan, TMST, Exposure Training, Discrimination Training, Visual Judgement