Reacting to the Terror Threat

Analysing, Controlling and Adapting to Meet New Threats

On 9 August 2006 British law enforcement arrested 24 people following intelligence reports that suggested an imminent terrorist attack. There are strong indications that terrorists planned to simultaneously blow up several aircraft using liquids that should be assembled inside an airplane cabin to make an explosive. This article discusses the problem of detecting liquid explosives, possible solutions as well as systems that should be implemented to be better prepared for new threats.

As a consequence of that terror threat it is now being discussed to prohibit liquids in cabin baggage. The underlying reason is illustrated in figure 1. The x-ray image of the bottle on the left contains a liquid explosive. The x-ray image in the middle depicts a bottle with a soft drink. The image on the right shows a bottle of mineral water. As you can see in the pictures it is not very easy to distinguish between the substances, at least for non-experts.

There are technologies in addition to conventional x-ray screening that could be used to detect liquid explosives more reliably (see cover story article by Smiths Heimann). These are rather mid-term solutions since they require substantial investments and additional technological development efforts. An effective short term method to prevent terrorists from bringing pre-prepared bombs using liquid explosives would be to prohibit all liquids from cabin baggage brought through screening checkpoints. Passengers would still be allowed to buy liquids from shops that are inside the security restricted area after the security checkpoint. However, such a new security measure would result at least initially in operational problems with substantial economical impact (reduced passenger flow, flight delays, etc.). Whether liquids in cabin baggage should be prohibited or not is a political discussion that is beyond the scope of this article. In the following it is discussed how we can increase security and efficiency in airport security screening and combine risk analysis, quality control, and rapid adaptation to new threats using modern integrated systems.

Fig. 1: Liquid explosives are not easy to distinguish from other liquids. Left: x-ray image of a bottle with liquid explosive, middle: x-ray image of a bottle with a soft drink, right: x-ray image of a bottle with mineral water.

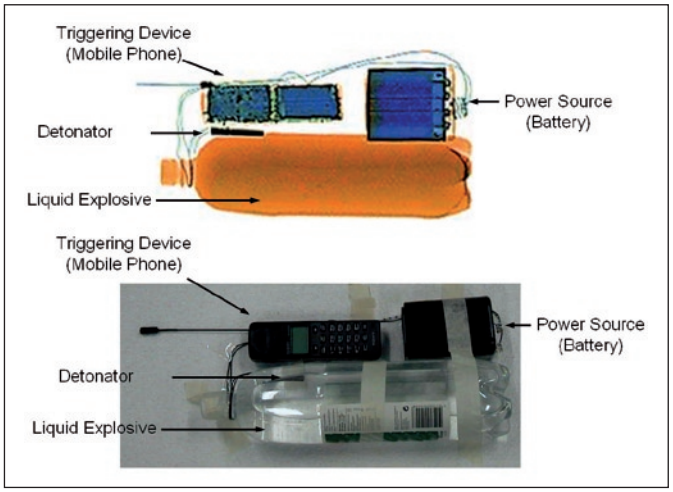

Fig. 2: The four components of a classical IED

Improvised Explosive Devices (IEDs)

Information on bombs and IEDs can be found on many internet sites, including homepages of computer based training (CBT) manufacturers. This article contains only some very basic information on IEDs. More detailed information on how to build homemade explosives, what types of detonators and triggering devices can be used etc. has been left out for obvious security reasons (unfortunately there are several terrorist websites where such information can be found publicly available on the internet, a problem that should be addressed in short term, too). There are many different ways of building one. However, classical IEDs have in common that they consist of four basic components (fig. 2): A detonator/initiator, a power source, explosive material, and a timer or other triggering device.

IEDs in hold baggage require these components to be effective. In cabin baggage, there are also other means that could be used by suicide bombers. Since IEDs are usually not encountered in the real life of a screener, it is essential that initial and recurrent training is provided in order to help screeners detecting them quickly and reliably. The importance of training is illustrated in figure 3. The bag on the left contains a device which is similar to the one depicted in figure 2. It is relatively easy to recognize once it has been learnt. However, the bag on the right of figure 3 contains another type of IED, which is made of different components using different explosive. If you have not learned to detect these different components it is quite difficult to identify the threat, which stresses the importance of training.

Fig. 3: Detection of IEDs is highly dependent on training. Left: The IED made with liquid explosive can be identified easily if this type is known. Right: This bag contains an IED made with other explosive and components, difficult to recognize without training.

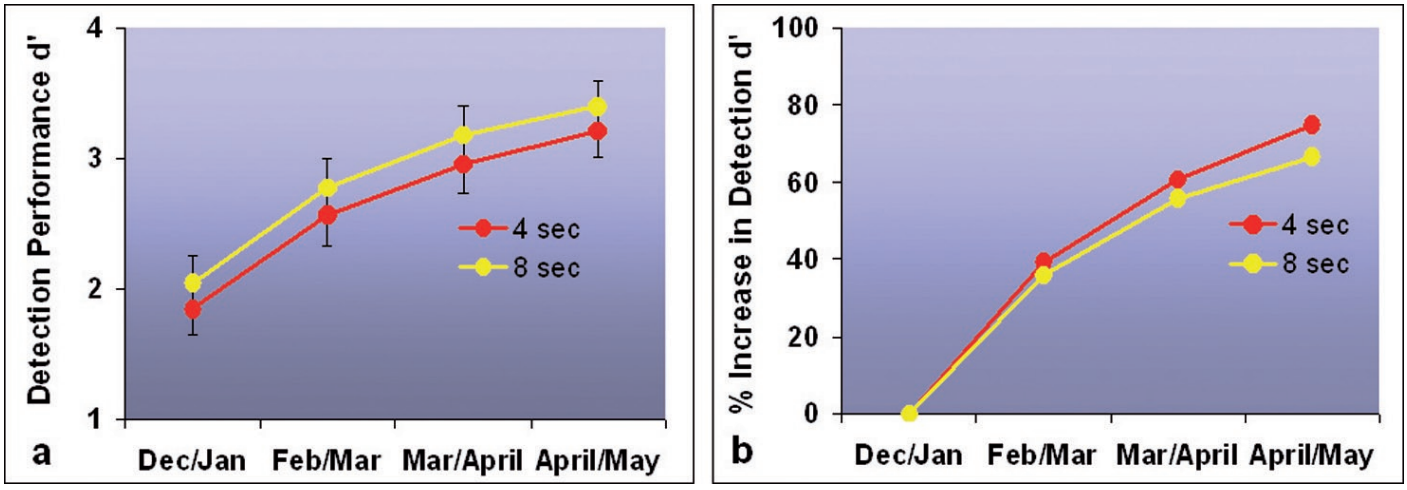

Fig. 4: Results of the study by Schwaninger and Hofer (2004) showing large increases of absolute detection performance (a) and percentage increase of detection performance relative to baseline measurement (b). During the four tests, x-ray images were displayed for four and eight seconds.

Individually Adaptive CBT

Scientific studies conducted over the last years have shown consistently that individually adaptive CBT can be a very effective tool to increase detection performance of screeners (Schwaninger & Hofer, 2004; Schwaninger, 2005b, 2005c; Ghylin, Drury, & Schwaninger, 2006). This is of particular importance for detecting IEDs in hold baggage which need to contain the four components described above to be effective (irrespective of whether they are made with liquid explosive or not). Figure 4 summarizes the results of a study conducted with 72 participants. None of them had received CBT before. For the period of six months, each week one to two training sessions of 20 minutes were conducted using X-Ray Tutor. This CBT system creates sessions adapted to each individual screener based on his learning history and thereby provides very effective and efficient training (for details see Schwaninger, 2003c, 2004b). Four tests were conducted in which new IEDs were used that had not been shown previously during training (for details of the study see Schwaninger & Hofer, 2004). As you can see in figure 4a, there were large increases of detection performance as a result of training. This was the case for both display durations of four and eight seconds. In order to assess training effectiveness we calculated percentage increase as compared to baseline measurement (first test results). As you can see in figure 4b relative detection performance was increased by about 70%. The analysis of response times revealed interesting findings with regard to efficiency. Training with X-Ray Tutor resulted in a much faster detection of IEDs. The response times for hits, i.e. correct decisions on x-ray images containing a threat item, dropped from about five seconds before training to about 3.5 after six months of training. For harmless bags average response times remained constant at about five seconds, consistent with a thorough search process.

In summary, these results show that individually adaptive CBT such as X-Ray Tutor can be a very powerful tool in order to achieve reliable detection of threat items within a few seconds of image inspection time.

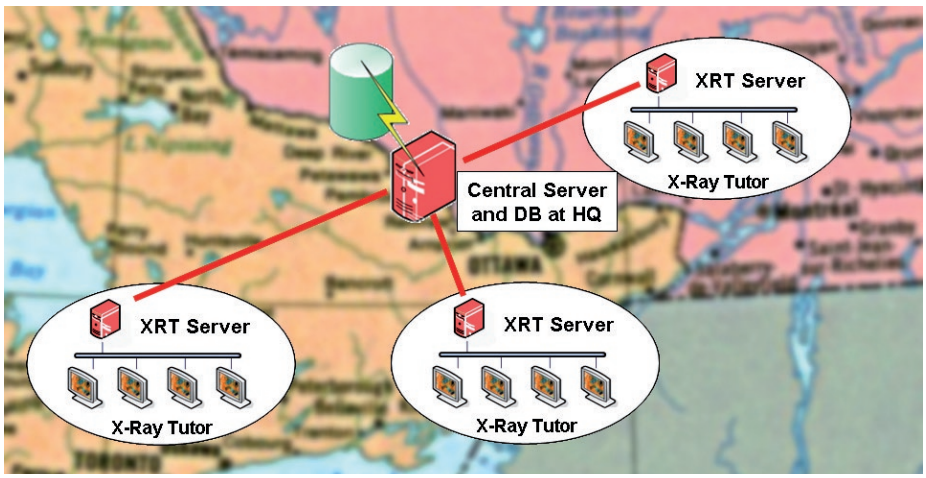

Fig. 5: Illustration of XRT Server Tools that connect different sites equipped with X-Ray Tutor to one central server and database (DB) at the headquarter (HQ).

New Threats

In the last years it has become clear that a more sophisticated approach is needed in which risk analysis, quality control, and rapid adaptation to new threats is possible by using modern integrated systems. Such a system is illustrated in figure 5 (XRT Server Tools). This networking system is operational since end of 2005 at several dozen airports (the X-Ray Tutor CBT itself is installed at more than 500 airports worldwide).

Report data containing screener performance from every site (different airports or airport locations) is transferred to a central database on a 24 hour basis. This allows constant performance monitoring for risk analysis and quality control purposes. XRT Server Tools provide also a centralized user administration. User data can then be automatically updated at all sites on a 24 hour basis. Future versions of XRT Server Tools will contain an Image Library Management plug-in (expected beta release date 4th quarter 2006). This will provide the possibility to distribute new x-ray images of threat objects to all sites on a 24 hour basis. When screeners conduct their training with X-Ray Tutor, they will be exposed to the most recent threats at the beginning of their training session. This will provide a rapid adaptation to new threats by a quick information transfer from intelligence and police sources to the airport security screeners at different sites.

References can be downloaded at www.psychologie.unizh.ch/vicoreg

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