By Mark Robins

Computer-Based Training for Transportation Screeners

CBT is an important tool to teach and increase screening competence and threat detection.

Computer-based training (CBT) plays a central role in improving the detection performance of transportation security screeners. Its primary function is to support the development of visual expertise in detecting threat items in X-ray images, which is an essential skill for maintaining high security standards, particularly in aviation. CBT enables systematic training of screeners using various imaging technologies, including single-view, dual-view and 3D computed tomography (CT). Through repeated exposure and practice in different visual conditions, screeners increase their competence to detect threat items effectively.

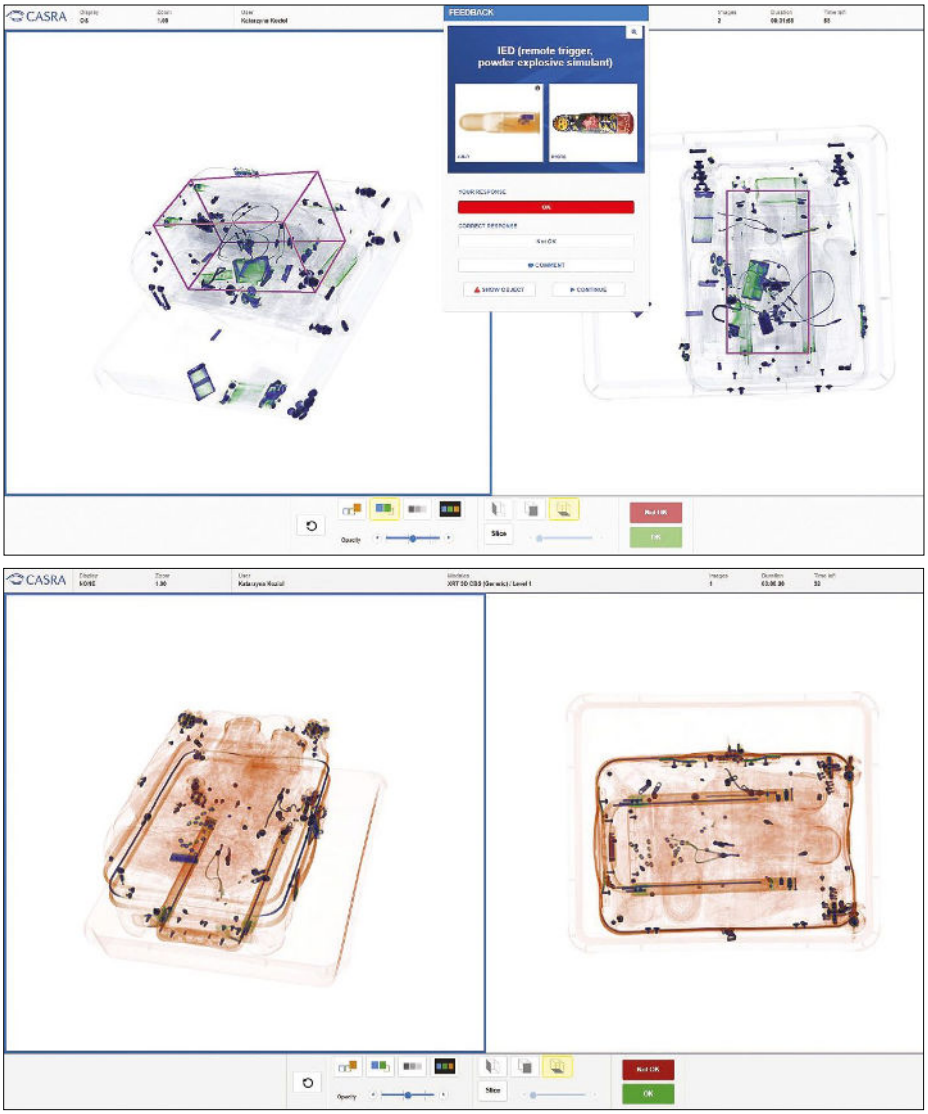
Important and Challenging

"A CBT program is important because screeners are rarely exposed to threat items during their routine work," says Dr. Stefan Michel, research scientist at the University of Applied Sciences and Arts Northwestern Switzerland (FHNW), Olten, Switzerland. "Consequently, they do not gain sufficient experience in detecting such items through real-life screening. CBT enables screeners to systematically learn to detect a wide variety of threat items under different visual conditions, such as different viewpoints, levels of superposition and bag complexities. Immediate feedback during the training process supports learning by helping

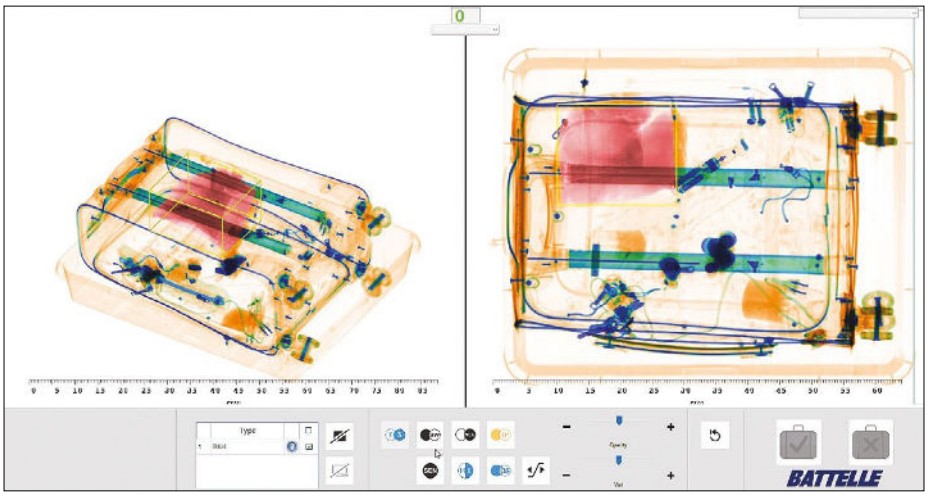
screeners understand their mistakes and improve their detection performance over time."

Computer-based training (CBT) for transportation security screeners must comprehensively cover the identification of a wide range of prohibited items. Screeners need to be exposed to these items in varied rotations, with different levels of superpositions, including items hidden beneath other objects and within complex baggage configurations. This variety ensures that screeners develop a robust ability to detect threats in real-world scenarios. Michel explains that, "Key challenges to address in CBT include balancing standardized training content with local operational requirements, ensuring that the training environment accurately reflects the complexity of real bags and threat items, and continuously updating threat libraries to keep pace with emerging risks."

Working at any transportation security checkpoint is indeed an important and demanding task. Michael Flaherty, division manager at Battelle, at Columbus, Ohio, believes that screeners have an extremely challenging job because, "Not only do they need to find every potential threat; they have to do it more quickly and efficiently than ever. Training time is limited, so it is incredibly important that every minute spent is impactful and effectively supports real-world performance."



CASRA says they have developed robust mental representations that enable screeners to generalize their detection skills to novel and evolving threats. CASRA image.



ProDetect's high-fidelity user interfaces precisely mimic each screening system and the ability to rapidly implement user interfaces for new systems coming to market. Battelle image.

Battelle has partnered with Security Training International (STI) with the goal of maximizing the benefit of training for every screener that uses Battelle's screener training platform, ProDetect. Built using Battelle's human factors expertise, this platform ensures that training is accessible, accurate and adaptable, to effectively meet the demands of today's screening workforce.

Screening Functions

CBT serves several key purposes; ultimately it enhances the visual-cognitive skills necessary for interpreting X-ray images. "Some CBTs allow content to

be adapted to an individual's learning progress and help organizations meet international regulatory requirements (e.g., ECAC, TSA, ICAO)," Michel says. "Research by the Center for Adaptive Security Research and Applications (CASRA) has shown that CBT, when grounded in cognitive psychology and supported by adaptive learning principles, leads to large improvements of detection performance. Moreover, CBT is a cost-effective, scalable training solution and a critical component of the security architecture of modern transportation systems."

Modern CBT programs for transportation security screeners, as developed by organizations like CASRA, focus primarily on interpreting X-ray images to identify threats such as guns, knives, improvised explosive devices (IEDs) and other prohibited items. Today's CBT programs use highly realistic threat images embedded in a wide range of bag configurations to mirror real-life screening scenarios. "The emphasis is not merely on rote memorization, but on developing robust mental representations that enable screeners to generalize their detection skills to novel and evolving threats," sources at CASRA say. "As well as standard cabin and hold baggage screening, modern CBT also covers the inspection of cargo, mail, air-supply items and staff belongings."

The needs of the screening workforce across the world vary widely — different technologies and systems, different screening protocols and operations, different baggage types and content. Also, training must be capable of being tailored to each specific screener's needs. Flaherty believes, "A one-size-fits-all approach doesn't work. Items seen by a screener in Alaska are much different than those seen by a screener in Dubai!"

ProDetect was designed to be highly adaptable to meet these specific needs. Its high-fidelity user interfaces precisely mimic each screening system and the ability to rapidly implement user interfaces for new systems coming to market. Through Battelle's partnership with STI, it has designed a screener training approach that provides an initial training regimen that evolves to a personalized approach over time as the screener gains further skills. New training content can be rapidly created and adapted to account for regional differences and to counter emerging threats.

CASRA's core training system is widely used across Europe and other regions worldwide. X-ray Tutor uses an adaptive training approach, with personalized difficulty levels based on screeners' performance. It also enables remote access, updates and centralized performance monitoring. The training solution also allows screeners to be tested and certified, providing a reliable

and valid competency assessment tool through the X-ray CAT. Sources at CASRA explain, "This tool is fully compliant with EU Regulation 2015/1998 and supports the mandatory regular certification of all security screeners, ensuring consistently high levels of competency in interpreting X-ray images."

Updated and Modernized

Security screener CBT has evolved significantly over the past decades. Early CBTs mainly focused on static, low-resolution X-ray images, providing limited interactivity. Image databases were small and included relatively simple prohibited items.

In contrast, modern CBT systems integrate high-resolution single-view, dual-view and even 3D computed tomography (CT) scans of passenger bags, providing a far more realistic and immersive training environment. A key advancement is the inclusion of adaptive algorithms that adjust the level of difficulty to suit the individual's learning curve. This personalized approach, combined with gamification elements and user-friendly interfaces, increases user engagement and motivation. Furthermore, modern CBTs utilize extensive and realistic image databases, ensuring a broad representation of both threat and non-threat items.

"CBT programs such as X-ray Tutor incorporate insights from cognitive psychology to support effective learning strategies," Michel says. "Training modules are continuously refined based on usability studies to ensure they meet the practical needs of end users. Furthermore, modern CBT platforms are often compatible with mobile devices and tablets, enabling flexible and accessible training anytime, anywhere. Research by CASRA has substantially contributed to this development. Their studies have helped define how image interpretation training should be designed to maximize learning outcomes. These insights have been published in several scientific articles and form the scientific basis for effective, evidence-based CBT programs."

Regulators, airports and their screening workforce demand highly accurate simulations of their specific systems. Training must be tailored and readily available whenever and wherever the screeners need it. Local and global administrators need the ability to effectively manage their workforces' training needs and regulatory requirements. These complex requirements, like so many other industries, demand an integrated solution

that helps users make sense of complex data. Battelle's ProDetect was designed with a data engine that captures every data point from every screener interaction during training. "Coupled with STI's OTS Management System, this deep dataset can provide administrators with insights into their workforce's performance — identifying potential gaps in detection, [establishing] the need for new training content and ensuring compliance with regulatory requirements," Flaherty says.

AI and Open Architecture

Many believe artificial intelligence (AI) is the next frontier in baggage screening. Michel explains that, "It is important to train security personnel in the appropriate use of AI-based support systems. Studies have shown that unreliable automation can reduce trust in such systems. When alerts are frequently incorrect or irrelevant, screeners may begin to ignore system suggestions entirely, a phenomenon known as the 'cry wolf effect.' Therefore, CBT should also include training elements that foster proper understanding of AI reliability and limitations, so that operators can make informed decisions when interacting with automated systems."

Flaherty predicts open architecture (OA) is going to continue to be a major driver across the aviation security industry. He believes OA has the potential to deliver significant efficiency improvements in the screening workflow, as more technologies and systems integrate to improve security and the passenger experience. "Ensuring that training evolves at the same rate as innovation is critical, especially as AI becomes a mainstay of every screening operation. Training data is no longer an afterthought; it will be key to understanding how human screeners and threat detection algorithms work together to detect threats. Leveraging AI to analyze enterprise-level training data against real-world performance will be critical in understanding how to better train, support and empower screeners to protect against the next generation of potential threats." TSI

Perceptual and Cognitive Skill Development

A key point often overlooked is that CBT is not just about knowledge acquisition, it's about perceptual and cognitive skill development. Screeners require deliberate practice to build expertise in threat detection. Research has demonstrated that not all candidates are capable of becoming skilled in X-ray image interpretation, even with comprehensive training. To support effective and efficient personnel selection, a standardized, reliable and valid test (e.g., X-ray ORT) enables organizations to identify suitable candidates from the outset. Furthermore, a competency assessment test (e.g., X-ray CAT) serves as a reliable, valid and standardized tool for assessing the image interpretation competency of transportation screeners. It fully adheres to EU Regulation 2015/1998, which requires that all screeners undergo regular certification to maintain a high level of proficiency in interpreting X-ray images. Moreover, good CBT systems are embedded in a cycle of personal selection, training and testing. Furthermore, since real threat items rarely appear at airport security checkpoints, screeners may experience reduced motivation and vigilance over time. To address this issue, Threat Image Projection (TIP) technology is very useful as it randomly inserts pre-recorded images of fictional threat items into baggage and other consignments being screened. This provides screeners with continuous practice in identifying threats. Additionally, their motivation is supported through the regular feedback they receive. Such TIP systems should be considered in addition to, rather than a replacement for, effective and efficient image interpretation training using CBT.

Information provided by Center for Adaptive Security Research and Applications (CASRA)

CBT is not just about knowledge acquisition, it's about perceptual and cognitive skill development. Screeners require deliberate practice to build expertise in threat detection. New Zealand History image.

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