Transportation Security Administration
Human Performance Branch

Cognitive Assistance at TSA

September 2020

RCA | REQUIREMENTS & CAPABILITIES ANALYSIS

TSA's Human Performance Branch and Cognitive Assistance

Human Performance Branch (HPB) Mission

Improve human performance and experience for staff and passengers at TSA (e.g. security effectiveness, efficiency, mental workload, morale) through better work design.

HPB and Cognitive Assistance

The HPB has worked on a variety of projects related to cognitive assistance in design. By understanding the physiological, psychological, social, cognitive, and behavioral aspects of work, TSA is better able to develop future technologies and processes that aid the workforce in decision making and solving problems.

A few examples of relevant HPB projects are:

- Travel Document Checker (TDC) Position Studies: CAT-2 and TDC Magnification Device
- Trust in Automation
- CT Common Graphical User Interface (CGUI)
- On-person Screening Interface Design

In addition to these projects, HPB coordinates with other agency on related projects, such as:

- DHS CAOE Deferring decisions: Effects on Human-AI Team Performance effort with ASU

Main Points for Discussion

- HPB research suggests designing human-machine systems to assist with job role tasks including decision making should be beneficial.
- The level of trust TSOs have in automation they use will likely effect overall system performance.
- Better user interface design can reduce human error and improve performance.

Designing to assist decision making at the TDC position

The Travel Document Checker job role is responsible for verifying an individual's identify before allowing entrance into the screening checkpoint or sterile area.

Currently, the TDC is expected to complete the following tasks:

1. Verify travel document (e.g., boarding pass)
2. Verify identification document (e.g., driver's license)
3. Verify ticketed traveler matches the person on identity document

TSOs at the TDC position are responsible for resolving or raising any potential concerns with travel documents or IDs. The HPB is currently assisting with two efforts to assist TDC decision making and alarm resolution: *Credential Authentication Technology 2 (CAT-2) and the TDC Magnification Device.*

CAT-2

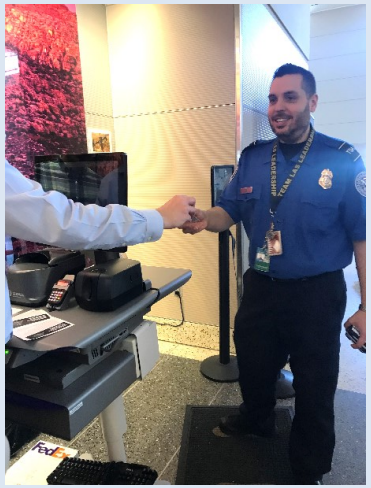
Description: In the early stages of the biometrics capability development, the HPB and HSI team conducted an as-is analysis of existing Travel Document Checker (TDC) systems and processes to better understand the role of the TDC. The recommendations developed were then used to help inform the design and creation of Credential Authentication Technology 2 (CAT-2).

Testing Activities:

- Identified and validated **knowledge gaps relevant to TDC processes** by reviewing prior task analysis work and conducting field data collections for standard TDC, CAT and CAT-2.
- Utilized a heuristic checklist of government and industry standards custom tailored to the TSA to assess the design of CAT and CAT-2 technology.

Outcomes:

- **Identified 32 usability issues** with the system, prioritized according to severity and probability.
- Briefed the vendor on these issues and design recommendations for improving the system.
- Recommend future test and evaluation.



Cognitive Assistance Impact: These efforts support the development of effective requirements to design user-friendly CAT-2 system. This system is intended to be a decision aid for the TDC position. When deployed, CAT-2 will complete the process of verifying passenger identity thereby reducing the cognitive burden on the TDC position.

TDC Magnification Device

Description: The Innovation Task Force (ITF), Systems and Risk Analysis Division (SRAD), and HPB conducted demonstrations, trainings, and assessments at Dulles International Airport (IAD) and TSA Headquarters in preparation for a rollout of a new TDC magnification device.

Counterfeit Indicators Training

- The Counterfeit Indicators Training for Enhanced Document Inspection taught TSOs the basics of **typical printing processes for genuinely issued ID documents**, best practices for identification of counterfeit indicators using the magnification device, among other information not previously covered in TDC training.

TDC Magnification Device

- During the Counterfeit Indicators Training, TSOs who work TDC operations learned how to leverage the new TDC Magnification Device to enhance counterfeit detection, both with and without CAT.

Outcomes:

- Training and performance testing show that TSO's ability to detect counterfeit documents was **improved after training and utilizing the device.**
- With the rollout of CAT and CAT-2, the TDC Magnification device will **assist officers in resolving alarms** raised by CAT.

Zarbeco Mi-Scope

Cognitive Assistance Impact: These magnification devices will act as decision aids for the TDC position to verify a passengers credentials are legitimate. This is a part of the larger effort to redesign the TDC job role to best assist officers with the associated tasks.

Trust in Automation Study

Description: Trust in Automation was a research project focused on measuring TSO levels of trust in automation and understanding the impacts system trust has on operator performance. The project outcomes supported the definition of technology requirements that prioritized the optimization of TSO trust in TSA technology and enhanced security effectiveness.

Outcomes:

- **Higher TSO detection rates correlate with higher TSO false alarm rates**, suggesting an inherent tradeoff between detection and efficiency
- **Reliance and compliance (behavioral indicators of trust) highly predict explosive detection** in the data set with a high degree of certainty, suggesting that this model can be recreated using operational data to predict detection
- Individual differences matter. Some TSOs were consistently better at explosive threat detection, suggesting that **aligning aptitude with task would improve threat detection.**

Rapiscan 620DV

Trust in Automation Study

Recommendations:

- **Determine the relevance of trust**. Exploration of the influence each of Human, Automation, and Environmental factors on TSO trust can help identify where trust is relevant at security screening checkpoints.
- **Determine the appropriate level** (how much), **type** (what function) and **mode** (how delivered) **of automation** for human-machine systems.
- **Design to minimize complacency**. Consider systems with variable reliability: inserting artificial failures of system-self-monitoring to reduce complacency. Make users aware of the reasoning process of the automation. Consider enabling operators to check the status and calibrate the system.
- **Consider both human and automation factors of design**. Raise awareness of distinction between false and nuisance alarms. Consider providing system certainty feedback to officer. Consider different levels of operator knowledge and understanding when developing interface and training materials.

Rapiscan 620DV

Cognitive Assistance Impact: Understanding how TSO trust impacts automation use can help define TSA technology requirements and enhance human system integration with screening technology, which can improve security effectiveness. For human-machine systems to be successful, the level of trust in automation must be properly calibrated.

CGUI efforts

Description: This effort was established to generate requirements for a CGUI for TSA. The project delivered a Computed Tomography-Accessible Property Screening System (CT-APSS) CGUI requirements document and a simulation tool for a CT-APSS CGUI to standardize interfaces across various vendors.

Expected Outcomes:

- **Enhanced TSO Screening Effectiveness and Efficiency** by using a standard interface designed to optimize operator performance
- **Increased System Standardization** with development of vendor-agnostic CGUI that provides airports the ability to use any vendor for system GUI upgrades
- **Optimized Training Efficiencies** through the use of a standard curriculum and training tools for screener training
- **Enhanced System Architecture Flexibility** by segmenting system hardware, the detection algorithms and the GUI, allowing improvements to be made separately in each layer

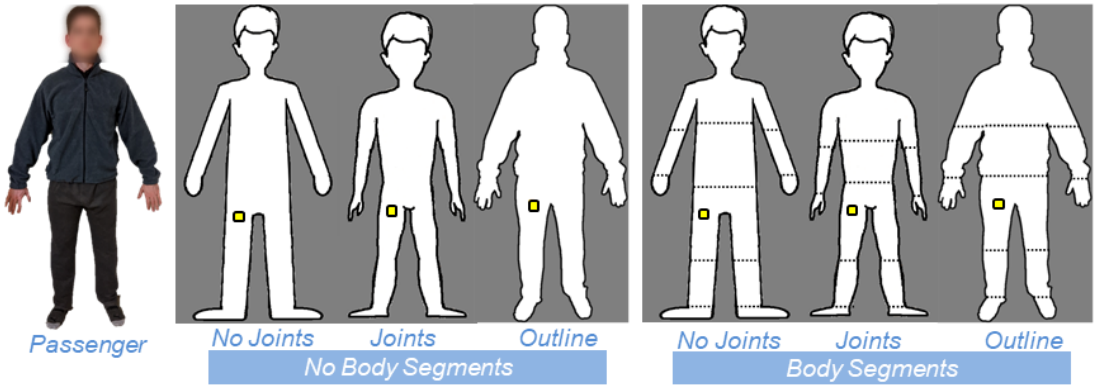
Default view of our CGUI Prototype

Cognitive Assistance Impact: This project includes efforts to identify the optimal display to minimize errors through the use of visual search aids and other interface design principles. HPB is helping influence better human-machine system design, and the CGUI effort is a good example of this process in action.

Optimized On-Person Screening Interface

OVERVIEW

TSA is looking to develop a next generation on On-Person Screening systems. Independent of the screening technologies, form factor and infrastructure used, an operator interface is needed to aid TSOs in the resolution of alarms. HPB is conducting user in the loop data collection to inform the design of the next generation interface that is planned to exist on a common workstation.



GOALS

- Investigate performance differences in finding alarms based on the presence or absence of body segments and joints on the RHF.
- This is a 2 (body segments: with segments v. without segments) x 3 (body shape detail: no joints v. joints v. outline) x 2 (passenger sex: male or female) x 2 (passenger clothing type: form-fitting or loose) repeated measures design.
- Results of this study will inform design of the RHF for future systems and whether or not body segment cues should be an active feature of systems in the field.

Some Optimized On-Person Screening Interface Possibilities

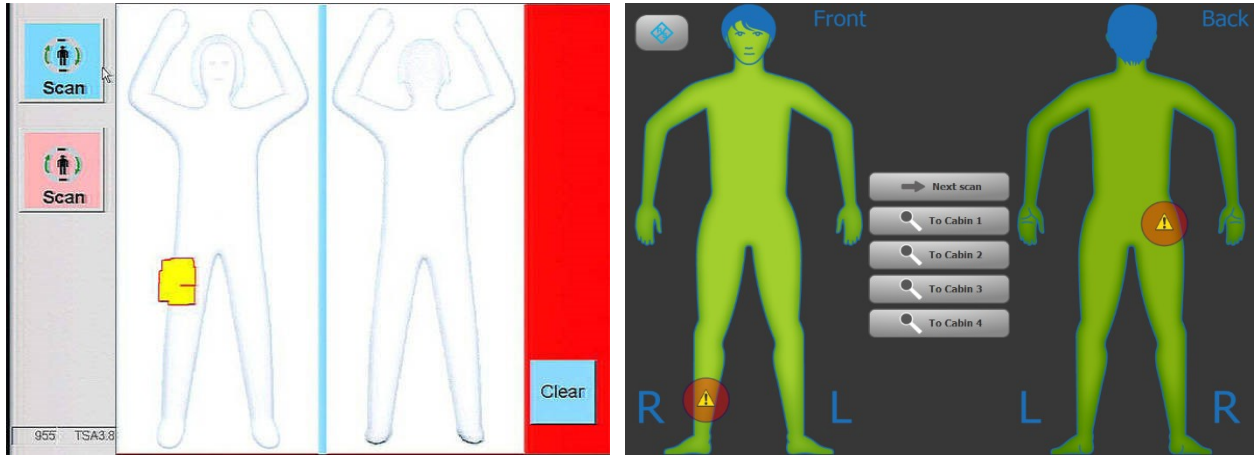


Figure 1 Examples of digital avatars and alarms for the L3 ATD (left) and R&S AIT (right)

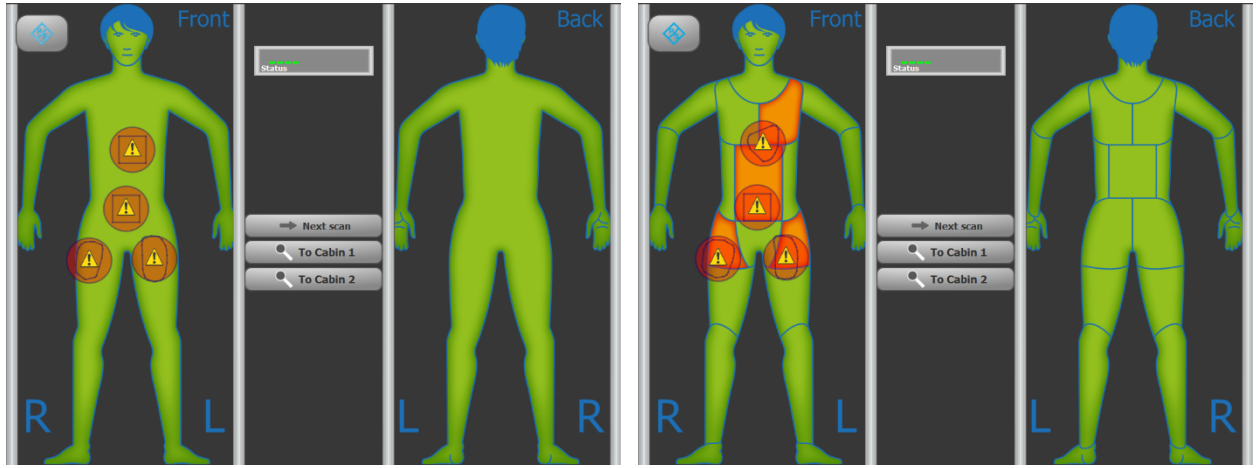


Figure 2 Examples of digital avatars without (left) and with body segmentation lines (right).

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Questions?