JDiBrief – Security

Visual Inspection with X-rays: ANALYSIS (3 of 5)

Author: Elena Rusconi, UCL Jill Dando Institute

TRANSMISSION X-RAYS: In X-ray transmission, matter particles (X-ray photons) are projected with a suitable energy through the items to be inspected and picked up by a detector at the opposite side. The resulting X-ray image is the distribution of those particles that have passed through the item and are recorded by the detector. Depending on content density of the item being screened, X-rays are subjected to different levels of attenuation, which are visually translated into different levels of grey and/or different colours. The final image is a two-dimensional projection of the density (i.e. attenuating properties) of all the three-dimensional objects placed along the paths of the X-rays. Transmission X-ray images comprise a cluster of shapes that may be represented from an unusual point of view, depending on their orientation inside the item to be scanned in relation with the X-ray source and detector. Shapes corresponding to objects that are present on different planes but along the same path in the scanned item will appear superimposed. Human screeners face the difficulty of interpreting complex images, and pattern recognition software does not seem to represent a valid substitute of the human visual system.

COMPONENTS OF HUMAN SCREENERS' PERFORMANCE: Actual figures on overall system accuracy and reliability (including the human component) and specific figures on screeners' performance are generally treated as classified information and never disclosed to the public. Academic research publications on studies with professional screeners tend to report normalised rather than absolute performance values (i.e. performance is expressed in relative terms, with reference to an arbitrary baseline). In-depth studies on human factors and the effect of experience are available, with an emphasis on aviation security screening. They focus on baggage screening and concern interventions to monitor pre- and post-training X-ray screening performance, to provide training and feedback. Specialized tasks that aim to test visual abilities in the context of X-ray images have been also used. These studies have collectively found that the interpretation of X-ray images and decision-making involves a range of psychological factors, among which pre-existing aptitudes. Based on research done in a different scientific tradition (i.e. neuropsychology and visual cognitive neuroscience), there is good reason to believe that an individual's ability to interpret X-ray images by identifying their component items may partly rest on a baseline set of skills that confers 'field independence' and can be measured before training.

HYPOTHESIS – With our research project we aimed to ascertain whether individual traits predicted differences in the ability to identify threats with actual security X-ray images. We suggest that threat detection in security X-ray images share challenges equivalent to those entailed by neuropsychological tasks such as the Embedded Figures Test (EFT; see the 'New knowledge' brief) where spontaneous attention to detail plays a key role. As such, one would expect that individuals with higher attention to detail should also have superior X-ray screening aptitude. We further hypothesise that it is possible to identify individuals who will perform better at security X-ray screening by administering a self-report instrument focused on autism spectrum traits.