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Eye Movements Associated with Recognition of Affect in Humans: Implications for the Detection of Concealed Firearm Carrying

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INTRODUCTION
In prior work the effect of gun carrying on the mood (i.e., affective state) of the surveillance target was assessed. In order to examine this effect, mock CCTV footage was generated of persons who acted as surveillance targets whilst concealing either a firearm or an innocuous object matched to the firearm (for a complete description of this aspect of the experiment see [1]). It was found that gun carrying was associated with increased dysphoria (i.e., an affective state characterized by hostility, anxiety or depression) which was in accordance with results from previous studies [2]. In a consequent study [3] the participants (i.e., observers) watched this footage and estimated the emotional state of surveillance targets without knowledge about the presence of a firearm (i.e., Affect Detection Task, ADT). Likert-scale questionnaires were used to provide the data about which cues convey information needed to identify the affective state in a firearm and non-firearm carrier.

In order to infer which parts of the body a person carrying a concealed firearm are relevant for performing this task without relying on the observers’ consciously reported strategies only, as it was done in the previous study [2], here the observers performed the ADT task, whilst their eye movements were recorded. The eye-tracking technique is known to be able to clarify whether involuntary eye-movements are related to attention emotionally accessing information presented in images [4], [5]. Applying this particular method in the current study is therefore believed to provide information about whether the perception of a particular affective state of carriers of concealed firearms is associated with a certain eye-movement pattern.

METHOD
Participants
12 postgraduates and members of staff from LU (5 females). Mean previous experience in surveillance.

Materials
• Tobii X50 stand-alone eye-tracker with ClearView 2.6.0 software.
For the set up of the experiment see Figure 1.
• Mock CCTV footage: in total 22 video clips (2 sec long) with 11 different surveillance targets in two conditions (concealed gun present; concealed innocuous object present).
• Affect Detection Adjective Checklist – Revised (MAACL-R; [6]): Two scales: Dysphoria (sub-scales: Anxiety, Hostility; Depression); PASS (sub-scales: Positive Affect and Sensation Seeking).

RESULTS

Performance on Affect Detection Task
When the Affect Detection Task was performed. The observed dysphoria in the Gun condition was higher than the observed dysphoria in the Innocuous Object condition (see Figure 3), which was consistent with the self-ratings of surveillance targets. However, this effect did not reach statistical significance.

Eye movement data
Friedman test was performed. Significant differences in mean fixation duration across three AOs (\(\mu_1 = 18.5, p<.05\) for Innocuous Object condition, and \(\mu_2 = 18.5, p<.05\) for Gun condition). Mean fixation duration across all participants on the ‘Body’ was significantly longer than on the ‘Legs’ in both Gun and Innocuous Object conditions (see Figures 4 and 5 for comparison).

Figure 3. The surveillance targets’ affective state, estimated by observers. The surveillance targets’ affective state is represented by the mean scores on the scales of MAACL-R in the Innuocuous Object (i.e., carrying an innocuous object) and Gun (i.e., carrying a firearm) conditions.

Figure 4. Comparison of the mean total fixation duration across different AOIs between conditions when surveillance targets were carrying a firearm (i.e., Gun condition) and when the surveillance targets were carrying a bottle (i.e., Innocuous Object condition).

Figure 5. Mean of the total fixation duration times spent within the different AOIs (i.e., Innuocuous Object, ‘Face’, ‘Upper body’, ‘Body’, ‘Lower body’, ‘Legs’) in two conditions, (i.e., Gun and Innocuous Object conditions).

No significant differences in the observers’ eye fixations duration on all AOIs between Gun and Innocuous Object conditions (see Figure 4).

Figure 6. Examples of two frame from a video sequence, demonstrating eye fixations and the three AOIs: ‘Face’, Upper body (‘Body’), Lower body (‘Legs’).

Conclusion
The aim of the affect detection task, along with the measurement of eye movements of observers, in the current study was to provide additional information about the cues which the observers are using to identify the affective state from human watching of surveillance footage accompanying the carrying of concealed firearms. The results of this study show that the observers’ attention manifested in a consistence interest in the face regions across all the conditions (gun and innocuous object). Furthermore, observers looked at the upper body (including arms and chest of the targets) longer than on the lower body, i.e. legs of the targets. The described pattern did not differentiate between the two conditions.

The duration of observers’ eye-fixations on lower body (‘Legs’) of targets was positively related to the estimated negative affect (i.e., perceived dysphoria, hostility and depression) when the target was carrying a firearm. Besides, more accurate estimation of negative affect was related to a longer time that the observers spent looking at the legs of the surveillance targets. More accurate estimation of positive affect seems to be related to a longer time the observers were looking at the upper body of the surveillance targets.

Although the eye movements of observers clustered consistently around the face regions of surveillance targets, the results suggest that when the targets were carrying a concealed firearm, their upper and lower body may have been used by observers as a cue to estimate the targets’ affective state. The attention to targets’ legs, which might be related to speed of walking, implies that cues such as speed of walking or the length of strides might be informative in the task of affect recognition of carriers of concealed firearms. Future research should further investigate the performance on the task of detecting a concealed firearm carrier in terms of eye movement patterns.

REFERENCES

Acknowledgements: This work is part of the M&I Environment Deployable Universal Software Application (MEDUSA) project which is funded by EPSRC grant number: EP/078830/1.