



# How robust is the evidence base for the human ability to recognise suspicious activity/hostile reconnaissance?

**LITERATURE REVIEW**

JULY 2023

ZOE MARCHMENT

PAUL GILL

# How robust is the evidence base for the human ability to recognise suspicious activity/hostile reconnaissance?

## LITERATURE REVIEW

Dr Zoe Marchment | University College London  
Professor Paul Gill | University College London

This literature review was produced as part of the CREST project: Factors That Deter Threat Actors And Reconnaissance. The project aims to develop our understanding of hostile actors' experiences and behaviour, including their target selection and reconnaissance, with the purpose of informing existing and new forms of deterrence. You can find all the outputs from this project at: [www.crestresearch.ac.uk/projects/factors-that-deter-threat-actors-and-reconnaissance/](http://www.crestresearch.ac.uk/projects/factors-that-deter-threat-actors-and-reconnaissance/)

### ABOUT CREST

The Centre for Research and Evidence on Security Threats (CREST) is funded by the UK's Home Office and security and intelligence agencies to identify and produce social science that enhances their understanding of security threats and capacity to counter them. Its funding is administered by the Economic and Social Research Council (ESRC Award ES/V002775/1).

[www.crestresearch.ac.uk](http://www.crestresearch.ac.uk)



# TABLE OF CONTENTS

|   |           |
|---|-----------|
| <b>EXECUTIVE SUMMARY .....</b>                                      | <b>4</b>  |
| <b>INTRODUCTION.....</b>  | <b>5</b>  |
| <b>METHODOLOGY .....</b>  | <b>6</b>  |
| <b>Identifying studies: databases and information sources .....</b> | <b>6</b>  |
| <b>Search terms .....</b>   | <b>6</b>  |
| <b>Findings .....</b>   | <b>7</b>  |
| <b>Experts v Novices.....</b>                                       | <b>8</b>  |
| <b>Context.....</b>   | <b>10</b> |
| <b>Stressors.....</b>   | <b>10</b> |
| <b>Training .....</b>   | <b>10</b> |
| <b>CONCLUSIONS.....</b>   | <b>11</b> |
| <b>BIBLIOGRAPHY .....</b>   | <b>12</b> |

# EXECUTIVE SUMMARY

---

- 7033 unique studies were sifted to identify studies that examined the human ability to recognise suspicious behaviour.
- 11 studies met the inclusion criteria.
- Seven studies looked at the difference in ability between experienced CCTV operators and controls; two looked at the influence of context; one on the influence of stressors; and one on the influence of training.
- No significant differences were found between experts and novices. Accuracy appears to be around chance level.
- Familiarity with an area may have a positive effect on detecting suspicious behaviour.
- Participants exposed to security cues while carrying out tasks were more often correctly identified by observers as either innocent or hostile based on their behaviour.
- Behaviour based training may increase an individual's ability to recognise suspicious behaviour.
- Individuals differ in cognitive and perceptual skills and therefore infer different meanings from viewed behaviour. These differences in the interpretation of cues may affect the ability to accurately detect suspicious behaviour.
- Cues of hostile intent may be difficult to interpret accurately due to the observer's absence of the perpetrator's baseline 'normal' behaviour with which to compare.
- Establishing non-verbal indicators of hostile intent that are accurate across many contexts is difficult. Observers need knowledge of 'normal' behaviour for each specific location.

---

# INTRODUCTION

---

Security procedures at large public venues and transportation hubs rely upon vigilant and engaged security officers who are tasked, in part, with timely and appropriate responses to suspicious behaviours (behaviour that seem unusual or out of place, that indicates that someone is in the process of planning or committing a malicious act) of potential hostiles (be they criminals, or terrorists) looking to victimise normal site users. This includes individuals conducting hostile reconnaissance, defined as “purposeful observation with the intention of collecting information to inform the planning of a hostile act against a specific target” (CPNI, 2016).

The presumption is that hostiles, armed with the ‘guilty knowledge’ of their true intention will behave or present in non-normative ways versus normal site users and thus provide opportunities for security to detect these suspicious behaviours (Gill et al., 2020). But how capable are individuals at detecting suspicious behaviour? This systematic review assesses the current evidence base for the human ability to accurately recognise suspicious behaviour.

The evidence for a narrower form of deception – lie detection – paints an interesting picture. In terms of lie detection, Bond and DePaulo’s (2006) meta-analysis found that just 54% of untrained observer judgments were correct, only slightly higher than chance. Performance was worse when observers could only see the target person (52% accuracy), than when they could only hear them (63%). However, liars are more nervous and more conscious of their own behaviour than truth tellers (Vrij, 2008; Vrij *et al*, 2019) and when being interviewed are aware that they are being actively observed and scrutinised. Those with hostile intent may not believe that they are being watched, but they may be vulnerable to the spotlight effect – a tendency to believe they are being noticed more than they are and as such overestimate the extent to which they are the focus of the attention of others (Gilovich *et al*, 2000).

# METHODOLOGY

## IDENTIFYING STUDIES: DATABASES AND INFORMATION SOURCES

Studies were identified using a keyword search of ProQuest Central. Full text versions of identified studies were obtained through one of the following means (in order of preference): electronic copies via the university’s e-journals service, electronic copies of studies available from elsewhere on the internet, paper copies, electronic/paper copies requested through the inter-library loan system (which sources most materials from the British Library) and electronic/paper copies requested from the authors themselves.

We used the following inclusion criteria; the study must:

- a. have examined the *human* ability to recognise suspicious behaviour (e.g., not the use of technology)

- b. have examined the human ability to *recognise* suspicious behaviour (e.g., not to determine the cues themselves)
- c. be an empirical study that reported at least one measure

The review considered peer reviewed studies that were published in print or available online up to May 2022. We chose to only include peer reviewed studies. Studies were limited to English because of the language skills existing in the team. The search strategy for the systematic review is based on the Campbell Collaboration method.

## SEARCH TERMS

In order to discover relevant items for the systematic review, a number of search terms were used in the above search engines and electronic databases:

|             |              |           |                |
|-------------|--------------|-----------|----------------|
| Human       | Detect*      | Suspicio* | Behav*         |
| Individual  | Identif*     | Suspect*  | Activity       |
| Participant | Surveil*     | Decept*   | Facial         |
| People      | Recogni*     | Decei*    | Object         |
| Person      | Track*       | Crim*     | Event          |
| Police      | Notic*       | Abnormal  | Indica*        |
| Officer     | Discern*     | Unusual   | Cue            |
| Public      | Distinguish* | Anxi*     | Movement*      |
| Witness     | Determin*    |           | Reconnaissance |
|             | Ascertain*   |           |                |
|             | Perceiv*     |           |                |

These search terms resulted in 7033 unique studies (once duplicates were removed) which required screening. The first level of screening involved the review team examining the title and abstract of those studies returned following our electronic and bibliographic searches resulting in 15 studies for full review. Next, the 15 studies were read in their entirety in order to rigorously judge whether they should be included in the full systematic review. In total, we found just 6 studies meeting the inclusion criteria. Forwards and backwards citation searches resulted in a further 5 studies for inclusion.

## FINDINGS

Table 1 summarises the details of each study and their findings. Most studies demonstrated that the ability to detect suspicious behaviour was below 50% (e.g., below chance), and that there were no differences in accuracy between experts and novices. One study showed that the observer's similarity with the area had a positive effect on detecting suspicious behaviour

| Study                          | Participants                                      | Task   | Findings  |
|--------------------------------|---|--|---|
| Blechko <i>et al</i> (2008)    | CCTV operators and inexperienced observers        | Determine whether someone was carrying a concealed firearm in CCTV footage | Performance was below chance<br><br>No significant differences found between the two groups   |
| Grant & Williams (2011)        | CCTV operators and inexperienced observers        | Predict anti-social acts in CCTV footage                                   | Proportion of correct incident clips was 51.4% for CCTV operators and 45.8% for controls (~chance levels)<br><br>No significant differences found between the two groups<br><br>Participants more accurate when they looked at the face/head of the individuals |
| Troscianko <i>et al</i> (2004) | CCTV operators and students                       | Observe CCTV footage and determine which scenes led to a criminal act      | 34% of both groups were correct in their judgment of what was going to happen next. 31% were close<br><br>CCTV operators showed bias towards judgements of criminality, whereas the students showed a bias towards innocence                                    |
| Wijn <i>et al</i> (2013)       | CCTV operators with different levels of expertise | Detect offenders in CCTV footage in familiar and unfamiliar areas          | No significant main effect of expertise<br><br>Familiarity with the area had a positive effect on detecting suspicious behaviour  |
| Crundall & Eyre-Jackson (2017) | Police officers and inexperienced observers       | Observe CCTV footage and determine which scenes led to a criminal act      | Police officers marginally more accurate in their predictions<br><br>Police officers more likely to predict that a crime was about to occur regardless of whether there actually was one  |

## METHODOLOGY

### The human ability to recognise suspicious activity/hostile reconnaissance

|                             |   |  |  |
|-----------------------------|---|--|--|
| Koller <i>et al</i> (2016)  | Police officers, criminal investigators, and students | Observe footage of individuals shortly before committing baggage theft in an airport   | All groups of participants were able to detect an individual who was about to steal something significantly above chance level<br><br>Significantly higher detection performance of those with more knowledge and experience |
| Regens <i>et al</i> (2017)  | Police officers                                       | Assessed text-based scenarios that contain a mix of non-suspicious behaviours, generic suspicious behaviours, traditional criminal behaviours and terrorism-centric behaviours | Those who had taken part in the training had an enhanced ability to recognise suspicious behaviours when compared to those who hadn't<br><br>Awareness of terrorism-centric behaviours increased 21.2%                       |
| Blechko <i>et al</i> (2009) | University students                                   | Determine whether someone was carrying a concealed firearm in CCTV footage   | Participants were able to differentiate between those carrying a concealed firearm and those carrying an innocuous object based on inferred emotional state  |
| Mann <i>et al</i> (2020)    | University students and staff                         | Observe footage of individuals on a ferry crossing and identify those tasked with smuggling an object  | Accuracy rate was 48% and 39%<br><br>Perceptions did not match the nervousness of participants   |
| Graham <i>et al</i> (2018)  | University students                                   | Participants watching the CCTV footage were instructed to look for a crime, look for something unusual, or to just watch the video   | Instructing participants to detect a crime, detect anything unusual or simply watch the footage produced no significant effect on eye movement behaviour   |
| Wijn <i>et al</i> (2017)    | University students                                   | Observed individuals with high or low cognitive load who were given a pre-defined route to travel to carry out a hostile or non-hostile task                                   | Participants with high cognitive load who were exposed to a strong cue while carrying out their task were more often correctly identified by observers as either innocent or hostile based on their behaviour                |

Table 1. Summary of findings

## EXPERTS V NOVICES

Seven studies looked at the difference in ability between experienced CCTV operators and controls. Troscianko *et al* (2004) compared the ability of experts and novices to detect potentially criminal behaviour in CCTV footage. They used 100 video clips lasting 15 seconds each. 18 of these were scenes that led to criminal acts such as assault or vandalism (classified as 'incidents'). A further 18 were matched, as closely

as possible, to the incident clips with respect to the characters' behaviours, age, dress style, type of location, and time of day (classified as 'matches'). 50 professional CCTV control room operators (who were unfamiliar with the locations in the clips) formed the 'expert' group. 50 undergraduate students formed the 'novice' group. The results suggested that the included crime scenes were distinguishable from matches and neutral scenes, and that there were predictive



behaviours in the footage that were recognised by both experts and novices. 34% of both groups were correct in their judgement of what was going to happen next, and 31% were close in the judgement (for example if they mentioned the perpetrator but were less specific about what actually happened). A response bias was found, where the CCTV operators showed bias towards judgements of criminality, whereas the students showed a bias towards innocence.

Grant and Williams (2011) followed Troschianko *et al*'s (2004) design to examine the effect of surveillance experience on the ability to predict anti-social acts using CCTV footage. CCTV operators (n=12) and inexperienced observers (n=12) participated. They found that participants were more accurate in their predictions of imminent criminal action when they looked at the face/head of the individuals in the footage. The proportion of correct incident clips was 51.4% for CCTV operators and 45.8% for controls (~chance levels). No significant differences were found between the two groups. Correct observers mentioned gaze more frequently than incorrect observers whilst explaining their predictions. Individuals who repeatedly looked around at others or made large, aggressive hand/arm gestures were viewed with suspicion. The most frequently mentioned (34%) of explanations given for suspicion were related to body language. Behaviours that were seen as provoking within the social context or seemed out of place were also considered suspicious.

Crundall and Eyre-Jackson (2015) also conducted a similar experiment using 10 CCTV clips, judged by 30 police officers and 30 control participants. Police officers were marginally more accurate in their predictions. A response bias was also found, with the police officers more likely to predict a crime regardless of whether there actually was one. This indicates that experience may lead to individual's being oversensitive to non-verbal cues.

Blechko *et al* (2008) found that CCTV operators and lay people did not significantly differ in their ability

to identify those carrying firearms, those carrying innocuous objects, and those carrying no additional objects. Determining whether someone was carrying a concealed firearm appeared to be related to how anxious the individual appeared. There was significant correlation between the number of times the individual was deemed to be carrying firearms and the individual's score. They conducted a further experiment using 31 students (Blechko *et al*, 2009), none of which had experience in detecting criminal behaviour, to identify whether firearms carriers could be identified based on observer's inference of their mood. Only clips using concealed objects were used. The results indicated that they were able to differentiate between those carrying a concealed firearm and those carrying an innocuous object based on inferred emotional state

Graham *et al* (2018) examined the fixation behaviour of change detectors and non-detectors monitoring dynamic scenes of either a mock crime or no crime. In the crime video, a phone was stolen after being left on a chair. It was not stolen in the no-crime video. Participants watching the CCTV footage were instructed to look for a crime, look for something unusual, or to just watch the video. Instructing participants to detect a crime, detect anything unusual or simply watch the footage produced no significant effect on eye movement behaviour.

Mann *et al* (2020) conducted two experiments in which half of the participants making a ferry crossing smuggled an object. Each participant was asked to report their level of nervousness, behavioural control, and self-consciousness, as well as any strategies they undertook to blend in. These crossings were covertly videoed and shown to observers who were tasked with detecting the smugglers. In the first experiment 48% were accurate in determining which of the individuals had been tasked with smuggling an object (not significantly different from chance). The perceptions of the observers of the individual's nervousness, behavioural control and self-consciousness did not match the self-reports of the participants. In the second experiment, which otherwise involved the

## METHODOLOGY

### The human ability to recognise suspicious activity/hostile reconnaissance

same procedure, an intervention was introduced whereby confederate participants were added and acted as if they were searching the area for someone. In this experiment, 39% of observers were accurate in determining the smuggling status of the participant (significantly below chance).

---

## CONTEXT

Two studies looked at the influence of context. Wijn *et al* (2013) looked at the effect of familiarity of an area on detection. They asked experienced and inexperienced CCTV operators from Rotterdam to view 11 video clips (five of which included footage from outside Rotterdam). Familiarity with the area had a positive effect on detecting suspicious behaviour. Participants performed better in a familiar location. They also had a tendency to select more individuals as possible offenders in a familiar location than in other, less familiar locations. They did not find a statistically significant main effect of expertise.

Koller *et al* (2015) conducted a similar study using footage of individuals shortly before committing baggage theft in an airport, either in the shopping or check-in area, judged by police officers, criminal investigators, and students. They specifically used footage that included three or more other people (possible distractors). They found that all groups of participants were able to detect an individual who was about to steal something significantly above chance level. This is not in line with other studies. They also found a significantly higher detection performance of those with more knowledge and experience. No significant gender differences were found.

---

## STRESSORS

One study examined the influence of stressors. Increased cognitive processing can lead to visible external cues. The impact of increased cognitive load can be further influenced by the addition of stressors. Wijn *et al* (2017) used randomised controlled trials

to examine the psychological mindset of those with hostile intent. Participants with high or low cognitive loads were given a pre-defined route to travel to carry out a hostile or non-hostile task. For both studies participants were exposed to either a strong or mild cue indicative of a security presence. In the first study a confederate police officer said, “code red noted”. In half of the trials, this was said while facing the participants (strong cue), whilst in the other half this was said while facing the opposite direction (mild cue). In the second study, a sound resembling a police walkie-talkie static. Videos of these journeys were observed by individuals who were asked to determine the intent of each participant. Observers were better able to distinguish those with hostile intent after a strong cue. Participants with high cognitive load who were exposed to the strong cue while carrying out their task were more often correctly identified by observers as either innocent or hostile based on their behaviour. The findings indicate that behaviour brought on by stressors (in this case a strong cue indicative of a security presence) facilitate the detection of hostile intent. This provides support for the use of randomised deployments of Project Servator, as well as its resolution conversation aspect.

---

## TRAINING

One study looked at the influence of training. Regens *et al* (2017) examined the impact of a training course that used a behaviour-based approach to the identification of suspicious activities and behaviour. They found those who had taken part in the training had an enhanced ability to recognise suspicious behaviours when compared to those who hadn't. Awareness of terrorism-centric behaviours increased 21.2%.

---

# CONCLUSIONS

---

Individuals differ in cognitive and perceptual skills and therefore infer different meanings from viewed behaviour. These differences in the interpretation of cues may affect the ability to accurately detect suspicious behaviour. Observers of the environment need knowledge of behaviours linked to hostile intent, however establishing non-verbal indicators of hostile intent that are accurate across many contexts is difficult. Cues of intent may not be expressed in cases where the crime is expressive or spontaneous. Where they are apparent, they may be difficult to interpret accurately due to the observer's absence of the perpetrators baseline 'normal' behaviour with which to compare. As these behaviours may deviate from situationally appropriate conduct observers also need knowledge of 'normal' behaviour for that specific location.

Of course, offenders can deliberately modify their behaviour to conceal intent. There may be overlap between normal and suspicious behaviour in the same situation. As well as difficulties in establishing a universal baseline of behaviour that is applicable in every context, problems also arise in keeping natural guardians vigilant. Tasking members of the public to perceive a scene as a whole, and then try to detect clusters of behaviour that differ from the baseline is not feasible. Security system operators may not have an increased ability to identify suspicious behaviours except for when they have an understanding of the norms of the given environment. Little is known about the strategies observers of CCTV use when monitoring and interpreting behaviour.

---

# BIBLIOGRAPHY

---

Blechko, A., Darker, I., & Gale, A. (2008). Skills in detecting gun carrying from CCTV. In 2008 42nd Annual IEEE International Carnahan Conference on Security Technology (265-271). IEEE.

Blechko, A., Darker, I. T., & Gale, A. G. (2009). The role of emotion recognition from non-verbal behaviour in detection of concealed firearm carrying. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting (Vol. 53, No. 18, pp. 1363-1367). Sage CA: Los Angeles, CA: SAGE Publications.

Centre for the Protection of National Infrastructure. (2016). Hostile Reconnaissance: Understanding and Countering the Threat.

Cooke N.J., & Winner J.L. (2008) Human factors of homeland security. In: Boehm-Davis DA (ed) Reviews of human-factors and ergonomics (3). *Human Factors and Ergonomics Society, Santa Monica, CA*, pp 79–110

Crundall, D., & Eyre-Jackson, L. (2017). Predicting criminal incidents on the basis of non-verbal behaviour: The role of experience. *Security Journal*, 30(3), 703-716.

Gill, P., Marchment, Z., Corner, E., & Bouhana, N. (2020). Terrorist decision making in the context of risk, attack planning, and attack commission. *Studies in Conflict & Terrorism*, 43(2), 145-160.

Graham, G., Sauer, J. D., Akehurst, L., Smith, J., & Hillstrom, A. P. (2018). CCTV observation: the effects of event type and instructions on fixation behaviour in an applied change blindness task. *Applied cognitive psychology*, 32(1), 4-13.

Grant, D., & Williams, D. (2011). The importance of perceiving social contexts when predicting crime and antisocial behaviour in CCTV images. *Legal and Criminological Psychology*, 16(2), 307-322.

Koller, C. I., Wetter, O. E., & Hofer, F. (2016). 'Who's the Thief?' The Influence of knowledge and experience on early detection of criminal intentions. *Applied Cognitive Psychology*, 30(2), 178-187.

Mann, S., Deeb, H., Vrij, A., Hope, L., & Pontigia, L. (2020). Detecting smugglers: Identifying strategies and behaviours in individuals in possession of illicit objects. *Applied Cognitive Psychology*, 34(2), 372-386.

Regens, J. L., Mould, N., Jensen III, C. J., Edger, D. N., Cid, D., & Graves, M. (2017). Effect of intelligence collection training on suspicious activity recognition by front line police officers. *Security Journal*, 30(3), 951-962.

Troscianko, T., Holmes, A., Stillman, J., Mirmehdi, M., Wright, D., & Wilson, A. (2004). What happens next? The predictability of natural behaviour viewed through CCTV cameras. *Perception*, 33(1), 87-101.

Wijn, R., van den Berg, H., & Lousberg, M. (2013). On operator effectiveness: the role of expertise and familiarity of environment on the detection of deviant behaviour. *Personal and ubiquitous computing*, 17(1), 35-42.

Wijn, R., van der Kleij, R., Kallen, V., Stekkinger, M., & de Vries, P. (2017). Telling friend from foe: Environmental cues improve detection accuracy of individuals with hostile intentions. *Legal and criminological psychology*, 22(2), 378-399.

Zhang, K., Frumkin, L. A., Stedmon, A., & Lawson, G. (2013). Deception in context: coding nonverbal cues, situational variables and risk of detection. *Journal of Police and Criminal Psychology*, 28(2), 150-161.

For more information on CREST  
and other CREST resources, visit  
[www.crestresearch.ac.uk](http://www.crestresearch.ac.uk)



CREST

CENTRE FOR RESEARCH AND  
EVIDENCE ON SECURITY THREATS