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Expertise in Crime Scene Examination: comparing search strategies of expert and novice Crime Scene Examiners in simulated crime scenes

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a. Cash tin

b. Footwear mark

c. Sole of shoe

d. Tool-marks on window

Figure 1 Stills from head-mounted camera video

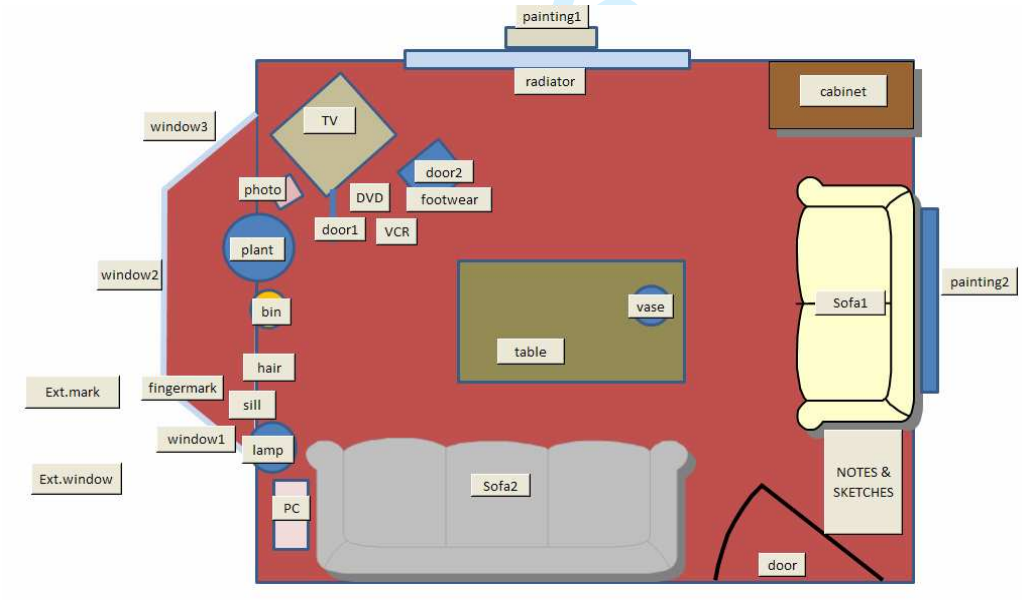

Figure 2: Activity Sampling sheet for the ‘Lounge

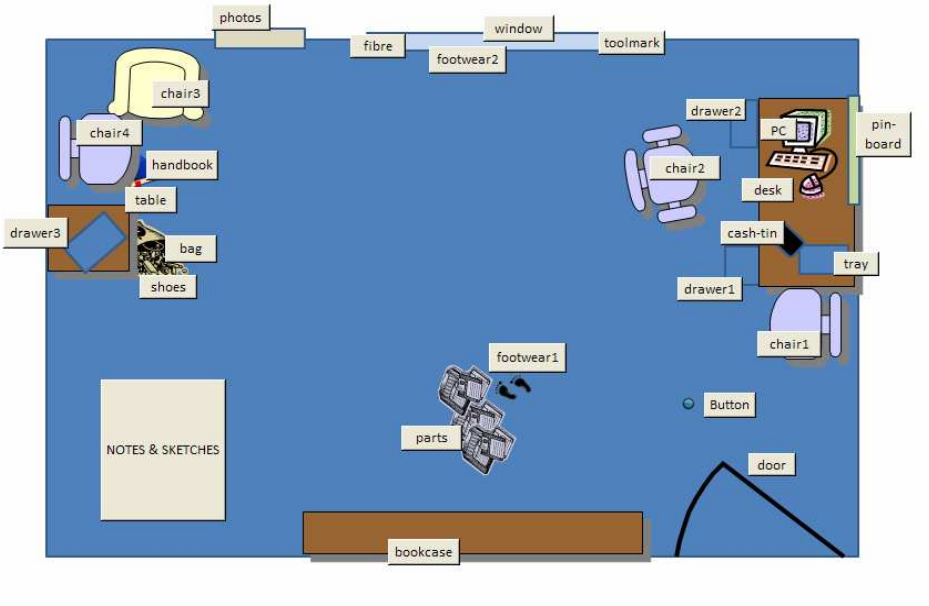

Figure 3: Activity Sampling sheet for the 'Office'

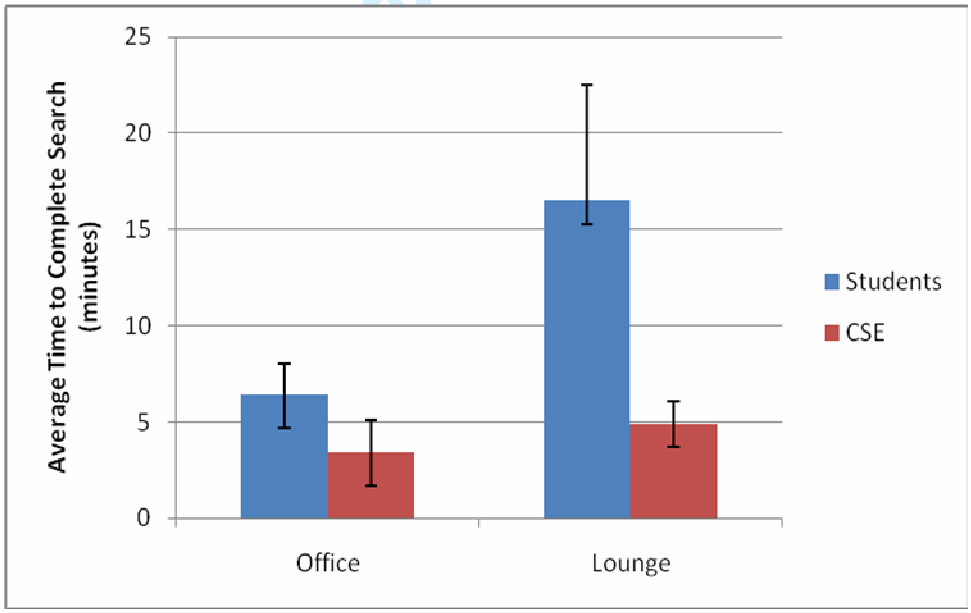

Figure 4: Mean search time for groups in the two conditions

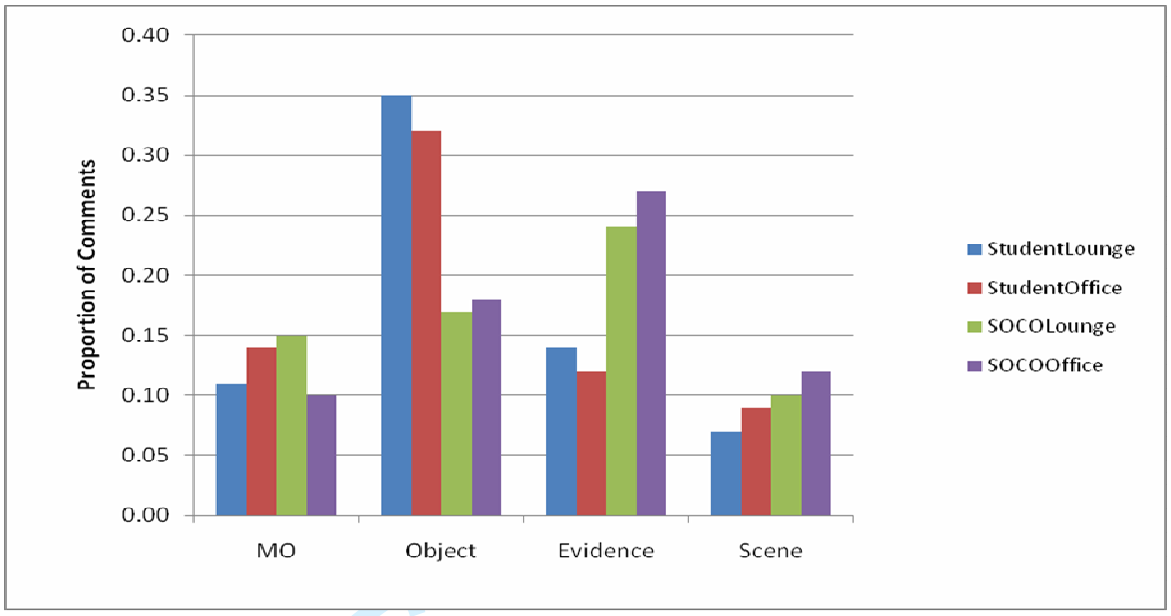

Figure 5: Mean number of statements for each category by each group per condition

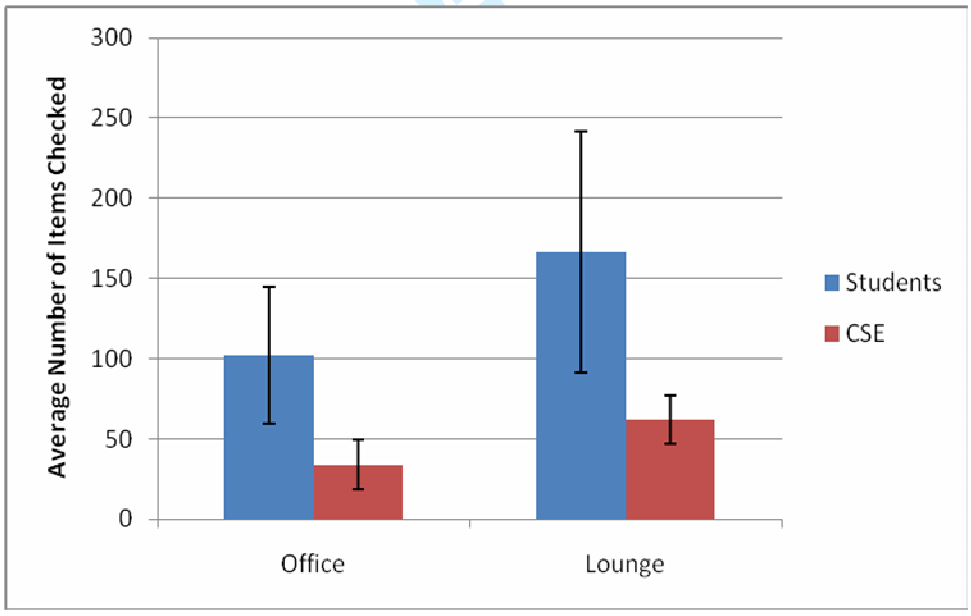

Figure 6: Mean number of items checked by each group per condition

Word count for main body: 4775 Word count for References: 951

Expertise in Crime Scene Examination: comparing search strategies of expert and novice Crime Scene Examiners in simulated crime scenes

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Abstract

Objectives: The strategies of novice and expert crime scene examiners were compared.

Background: Previous studies have demonstrated that experts frame a scene through reconstructing the likely actions of a criminal, and use contextual cues to develop hypotheses that guide subsequent search for evidence.

Methods Novice (first year undergraduate students of crime scene and forensic sciences) and expert (experienced crime scene examiners) examined two 'simulated' crime scenes. Performance was captured through a combination of concurrent verbal protocol and own-point recording, using head-mounted cameras.

Results: While both groups paid attention to the likely *modus operandi* of the perpetrator (in terms of possible actions taken), the novices paid more attention to individual objects, while the experts paid more attention to objects with 'evidential value'. Novices explore the scene in terms of the objects that it contains, while experts consider the evidence analysis that can be performed as a consequence of the examination.

Conclusion: The suggestion is that the novices are putting effort into detailing the scene in terms of its features, while the experts are putting effort into the likely actions that can be performed as a consequence of the examination.

Application: This distinction is considered in terms of developing expertise of novice crime scene examiners and approaches to training of expertise within this population.

Keywords: Crime Scene Examination, Expertise, Own-point recording, Verbal protocol analysis

Expertise in Crime Scene Examination: comparing search strategies of expert and novice Crime Scene Examiners in simulated crime scenes

A core aspect of the expertise of the Crime Scene Examiner[1] (CSE) lies in the ability to recognize places to recover materials that could yield evidence (Baber, 2010). Santilla, Korpela & Häkkänen (2004) demonstrate how experienced investigators of car crimes are better able than novices to find links in a series of crimes. This implies an ability to see general patterns in the evidence rather than a focus on specific instances (McRobert, Williams, Ward & Eccles, 2009; Raab & Johnson, 2007). Schraagen & Leijenhorst (2006) studied the behavior of forensic scientists searching for particulate material on clothing, and found that experts were better than novices at knowing where to target their search. This selection arose from the experts mentally reconstructing the actions or *modus operandi* of the suspect in that crime scene, and resulted in more forensic evidence being recovered by the experts. These studies chime well with the general literature on expertise. The expert is, by definition, often better able than the novice to appreciate the key information in a problem (Abernethy, Neal & Koning, 1994; Charness, 1979; Chase & Simon, 1973; de Groot, 1965; Didierjean & Fernand, 2008). Thus, compared with novices, expert physicians select a greater number of *relevant* cues from a case history (Joseph & Patel, 1990), and tend to generate a small number of working hypotheses early in the history-taking process, when

[1] In the UK, the role of the Crime Scene Examiner (CSE) is distinct from that of the forensic scientist or other investigators who might attend a crime scene. Typically, the CSE will be a civilian attached to a Police Force with the primary goal of gathering evidence to pass on, via an Exhibits Officer, to other parties for subsequent analysis in a laboratory (usually by forensic scientists). As such, the CSE will most likely attend 'volume crime' scenes, focusing on crimes such as: Street Robbery, Burglary, Theft (including shoplifting), Vehicle Crime, Criminal Damage (ACPO, 2002).

relatively few facts are known about the patient (Joseph & Patel, 1990; Kassirer & Gorry, 1978; Patel, Arocha & Kaufman, 1994).

These studies, however, do not mean that the expert is not prone to bias or error. In a series of experiments into the interpretation of fingerprints, Dror and his colleagues have shown that it is possible to induce bias in analysts' assessment of fingerprint-matching through the provision of background information describing the nature of a crime (Charlton, Fraser-Mackenzie & Dror, 2010; Dror & Charlton, 2006; Dror, Péron, Hind & Charlton, 2005).

One can situate the concept of 'CSE expertise' on two dimensions. The first concerns the constraints that a particular mode of working imposes of the individual, particularly (for crime scene examination) in terms of time pressure (Smith, Baber, Hunter & Butler, 2006). It is hypothesized that the expert CSEs will seek to complete the task more quickly than (novice) Students. The second dimension of CSE expertise concerns the ability to recognise *evidential value*. It is proposed that this recognition of evidential value is, in part, analogous to interpreting symptoms in diagnostic activity. However, recognition of evidential value also requires the 'expert' to judge whether the recovered object can be useful to someone else. In this case, this will require appreciation of the methods applied by forensic and other scientists to the recovered materials. Thus, it is hypothesized that, in addition to describing the *modus operandi* to explain the likely places to search for evidence, the expert would also consider the potential evidential value of the material and its potential utility for subsequent analysis.

Method

The study is conducted in a 'Crime House', i.e., an environment for training crime scene examination. Crime Houses allow video recording from ceiling mounted close-circuit television (CCTV) cameras, which can be used to support debriefing during training exercises. It was felt that these recordings would not provide sufficiently fine-grained detail for this study. Hence, head-mounted cameras were used to capture the participant's forward-view. Omodei, Wearing & McLenna (1997) explored head-mounted video recording as a methodology for studying naturalistic decision making by fire-fighters, which they termed *own-point recording*.

Initially, we intended to use a wearable eye-tracking system (the ASLMobileEye system) to capture search activity. However, fluctuations in ambient lighting disrupted the infra-red tracking. The study used own-point recording supplemented with concurrent verbal protocol. Eccles, Walsh and Ingledew (2006) asked orienteers, of varying abilities, to run courses while wearing head-mounted cameras with instructions to declare the focus of attention when it changed (e.g., to say 'map' when looking the map or 'travel / ground' when running, or 'looking for bridge' when searching for a specific object in the environment). These instructions helped with the coding of the video. The results indicated that, while experienced orienteers ran the course faster, there were no differences in proportion of time spent attending to these different categories of visual cues. While the Eccles et al. (2006) approach, of requiring participants to use speech to tag different activities, was appropriate for the more dynamic context of that data collection, we chose a method that provided us with a more detailed report from participants.

Ericsson & Simon (1993) distinguish between verbalizing the thoughts that occur to a person when performing a task and the justifications that the person uses to explain their task and claim that "...*only information in focal attention* can be verbalized." (p. 90). This distinguishes between verbalization of information-as-heeded (level 1) from information-as-encoded (level 2) or information-as-explained (level 3). Thus, level 3 verbal protocols are said to exhibit reactivity in that the verbalization changes the nature of the task being performed. Ericsson & Simon (1993) note that when participants provide level 1 or level 2 verbalization, then performance appears to be similar to conditions without verbalization, but when asked to produce level 3, then performance can change as a result of interference between performing the primary task and producing the verbal report.

A challenge with the use of the think-aloud verbal report method, particularly in dynamic, real world environments, is to provide sufficient task instruction and feedback to maximize level 1 or 2 verbalization by participants (Fox, Ericsson and Best, 2011). Despite our best efforts in this regard, the constraints inherent in the present experiment mean that it is not possible to guarantee that the protocols are entirely free from level 3 verbalization. To take a section from the example provided later in the paper: *"I can also see something's been covered over with…erm…plastic and I take it this is the footwear mark that was mentioned in the brief."*- is interpreted as information-as-heeded because it indicates the content of the verbal protocol describing the items in the scene. *"What I am looking at now is how would I actually get into this window, what would I hold onto..."* - is interpreted as information-as-encoded because it indicates the focus of attention on the search of scene, i.e., in terms of the *modus operandi* that the perpetrator might have followed. As such, we chose this method because the value added from the information obtained, even if approaching "level 3"

verbalization, provided us with important insights into reasoning processes that could be used to guide later studies and training.

Environment

The experiments took place in the Crime Houses of Teesside University in Middlesbrough, a city in the North East of England. The Crime Houses consist of three mid-terrace houses, with briefing and preparation rooms and a dozen or so rooms that have been furnished to represent different locations, including office, bedroom, pub, and lounge. Each room can be 'dressed' to stage a particular crime, with damage or markings on point of entry, or marks from fingers, feet or tools around the room, or biological evidence. Each room has closed-circuit television cameras and the video is passed to a central video-recording and editing suite from which the experimenters were able to monitor the search activity.

Setting the Crime Scenes

Two rooms were dressed to simulate burglaries. To control the presentation of initial information and ensure consistency between each participant one of the experimenters played the part of the key-holder who would meet the examiner and provide a brief explanation of when the crime was discovered.

Scene One: Lounge

A lounge on the ground floor had an open window, which had been forced, from the outside, with a flat bladed instrument causing striation marks in the uPVC frame. The latch of the window was unscrewed and the screws left on the ground under the opened window. A footwear mark had been left on the external window sill. This mark had been covered with black plastic by the first police officer responding to the incident. Inside, the television cabinet had been damaged, a DVD player had been pulled out of the cabinet and the glass door pulled off its hinges. A footwear mark was left on this door, along with glove marks.

Glove marks were also left on other surfaces within the room, i.e., the multi-plug socket behind the television unit, inside the windows transom bar, and on Nokia mobile phone box left on a sofa. The police log for the Lounge scene was:

> *06:13 Complainant Simon Pendle states his property has been burgled in the night whilst he was asleep. Attempt made to steal DVD player, wallet containing £50 cash and cards taken. Apple iPod touch and Philips DC910 iPod decking system also believed stolen. Total value around £1k. No signs of disturbance in other rooms.*
>
> *08:13 Update PC 2324 Gibson at scene. Crime Scene resource will be needed, will update with further details.*
>
> *09:06 PC 2324 updated: Crime report taken and brief house to house, nothing seen. Entry via front lounge window, pushed-to due to inclement weather. Good footwear preserved on the outside of the property window sill. Since arrival complainant couldn't find vehicle keys and on checking the rear car parking vehicle is believed to have been stolen. Request update PNC, vehicle is a Ford Fiesta registration details T75SPJ value £800, incident reported to have occurred overnight whilst complainant asleep. Complainant needs to go to work and is arranging lift; key holder (@ No2) is a neighbor and will stay with CSE. Availability all day.*

Scene Two: Office

The second scene was an office. The office window was forced open from the inside and the window opened a few centimeters. Footwear marks on the wooden floor matched footwear inside a plastic bag under a table. The scene could be interpreted as indicating that the complainant had faked the crime for insurance purposes. The simulated police log for the Office scene was:

> *17:00 Complainant Mr Jarvis reporting a burglary, address No 4 King Edward Square. He states that only one room searched as alarm not activated.*

Computer and electrical items from his office have been taken: New Acer Aspire 7720G laptop computer value £545, a Samsung ML-1640 Mono laser printer value £70, a TomTom One XL Classic SAT NAV along with £425 from the desk drawer.

18:27 PC 2142 updating arrival at address.

19:38 PC 2142 updated, scenes of crime requested, entry believed by forcing top opening window, force marks observed. Footwear marks on floor of office reported not being there the previous day. Confirmed no other rooms disturbed, alarm sensor in landing and alarm not activated. Exit as Entry. House to House completed, elderly occupant next door states nothing seen or heard. Complainant available for a visit all evening and all day tomorrow.

Participants

Twelve participants volunteered to undertake searches of staged crime scenes: six full-time, experienced Crime Scene Examiners (5 male, 1 female; mean age approximately 37 years; mean experience approximately 12 years) from 3 different Police Forces in the North East of England and six first-year students on a forensic degree pathway at Teesside University in Middlesbrough, UK (3 female, 3 male; mean age approximately 21 years). The students had attended introductory lectures on crime scene examination but had not conducted an exploration of a scene before. While it was possible to recruit more students (indeed, subsequent trials have been conducted with the complete cohort of the year), it was decided to balance the two groups in terms of numbers. Recruiting serving crime-scene examiners required not only their consent but also permission from their manager to release them from planned duties and allow them to spend time on the trials. This severely limited the availability of operational officers to participate in the studies.

Procedure

Participants were briefed on the aims of the study (to explore how crime scenes are searched) and given an explanation on the data collection methods (own-point recording and verbal protocol). If they wished to continue with the study, they donned the head-mounted camera and a short introduction session was completed.

Participants were handed a scene log (as shown above) for the first crime scene to be examined. Presentation of scenes was counter-balanced across participants to minimize practice effects. The details follow the conventional format of a crime report that is received by the CSE prior to attending a job. This would indicate the location of the scene, the person to contact, and a brief description of the likely crime to be examined. Once they had read the paper and were satisfied that they understood it, participants were led to the scene.

Participants searched the scene for as long as they wished. Own-point recording was made using the forward-facing camera of the ASL MobileEye system and a separate head-mounted microphone was used to record the verbal protocol. Audio and video recording was made on the same analogue video recorder that the participant wore. Video from the head-mounted camera and verbal protocols were recorded for subsequent analysis. The main objective for the participants was to select objects that they felt would be most useful to recover as evidence. Thus, the focus of the exploration was on evidence identification and selection.

Data Analysis

Prior to statistical analysis, the recordings of 'talk-aloud' commentaries and own-point recording data were coded.

Verbal Protocol

Each participant's 'talk-aloud' commentaries were manually transcribed. An initial coding was applied to categorize statements into one of four types:

i. Reference to the *modus operandi* of the perpetrator: describing likely point of entry or activity in the room or possible motive;
ii. Reference to objects in the room: desk, chair, computer parts etc.;
iii. Reference to analysis: toolmarks, fingerprints, footwear marks, fiber
iv. Reference to the room's features: type of flooring;

The following extract is from a male CSE (age 45 years; experience 15 years).

> *"Er…arrived at the scene…er…of the outside of the house…er…identifying the point of entry. Just confirming that [.] came from, from information from the IP via the OIC who attended the scene. I can see damage (.)…erm…I can also see something's been covered over with…erm…plastic and I take it this is the footwear mark that was mentioned in the brief, and I can see a skid footwear mark on there. What I am looking at now is how would I actually get into this window, what would I hold onto (0.5+) and I think that footwear mark would be consistent with somebody climbing up onto there so my (0.5+) next action would be to photograph the outside of this (.) point of entry."*

The coding of this extract is shown in table 1.

TABLE 1 ABOUT HERE

Coding was undertaken by both authors and an acceptable level of agreement was reached ($r^2 = 0.93$).

Video Coding

Figure 1 shows a set of stills from the video produced by a female CSE (age 37; experience 8 years). This illustrates the categorization of Objects checked from the video. In (a) the Object in the center of the frame is the cash-tin; in (b) the center of the frame is the footwear mark; in (c) the center of the frame is the sole of the shoe; in (d) the center of the frame is the edge of the window, and one can detect tool-marks around this point.

FIGURE 1 ABOUT HERE – scene from head-mounted video

The stills illustrate the problems of ensuring definitive identification of the object that the person was checking. For example, still (b) is taken some 2 minutes into the search and the analysis would suggest that the 'check' was being performed on the footwear marks on the floor, but the 'check' could be on the computer parts, or the floor covering, or some other aspect of scene. Consequently, a method to allow activity sampling that was sufficiently context-dependent to reflect behavior in each scene while allowing a level of consistency in identifying objects checked was required.

All of the 'Objects' categorized from the verbal protocols of CSEs and students were collated into a single set of 'Objects' (one for each scene). This provided the baseline for identifying checks. It is accepted that there could be objects in the scene that were checked but not mentioned in the verbal protocol, and this was considered during the analysis. However, review of this list of Objects relative to the construction of each Scene led to the conclusion that the list was exhaustive.

To resolve the question of *which* Object is being checked, the experimenters made a first-pass (with audio recording off) using own-point recording (supplemented by any "eye-

tracking" data if available[2]). This first-pass was supported by an application, written in Visual Basic for Applications (VBA) in Microsoft Excel. Each object from the collated verbal protocols was marked on a sketch of the room. When the analyst felt that the participant performed a 'check' on this object, then the corresponding button was clicked (see figures 2 and 3). The definition of 'check' in this analysis is quite loose, but means that the center of the video frame contained an object for longer than half a second. This meant that periods of attention in which the gaze swept around the room was not recorded in this analysis. Following this first-pass, a second-pass was performed with audio recording on. If the participant referred to an Object in their verbal protocol while this Object was in frame, this was used to infer that the Object was being checked. It is accepted that looking at an Object need not indicate that the person is attending to or checking it, but it was felt that this provided a pragmatic means of determining which Objects were felt to warrant checking by participants. Coding was undertaken by both authors and a reasonable, if somewhat low, level of agreement was reached ($r^2 = 0.68$)[3].

FIGURE 2 ABOUT HERE – activity sampling interface for Lounge

FIGURE 3 ABOUT HERE – activity sampling interface for Office

[2] Given the variation in illumination levels, the cross-hairs, indicating fixation, tended to be lost when the participants approached the windows in either scene, but would be present away from the window. There were two participants in the Student group and one participant in the CSE group who had no usable eye-tracking data on the video. Of the remaining video, we would estimate that between 30% to 60% of the video had the cross-hairs present, but that this was not uniformly split across participants and varied with location in the room. Thus, we decided to use this information to supplement ratings when it was available.

[3] The main cause of this difference in agreement lies in the definition of 'checking' applied by the two authors. Given the head movements involved in scene inspection, there were times when the gaze passed over objects and it was a matter of conjecture as to whether the participant had 'looked' at the object. In some instances, this was resolved through consultation with the audio recording; in other instances, the authors reviewed their independent assessment to reach consensus. We haven't included r^2 following this procedure (because the process resulted in an agreed unanimity). However, it is worth noting that subsequent analysis is based on the agreed set of object checks.

Results

Time to Conduct Search

The average time to conduct a scene differed between the two scenes, with participants spending less time in the Office than the Lounge (see figure 4). The time to conduct the search was defined as the time from the participant entering the room to them reporting that their search was complete.

FIGURE 4 ABOUT HERE – mean search time for groups in the two conditions

Mann-Whitney U tests were calculated to compare the two groups on their times to search the office and the lounge. The Students spent more time than CSEs searching the Office ($U = 4, p = 0.025$) and the Lounge ($U = 0, p = 0.002$). The students spent significantly more time searching the Lounge than the Office ($U = 0, p = 0.002$), but there was no difference in search times for the CSEs ($U = 9, p = 0.15$).

Verbal Protocol

The categorized verbal protocol data indicate that the total number of statements produced by the students averaged 26 statements, and the CSEs produced an average of 19 statements. Thus, there was some difference in the total number of statements made. A Two Independent Sample Wilcoxon Rank Sum Test indicates that there was a significant difference between the two groups of participants ($Z = -2.309, p = 0.021$). Figure 5 shows the relative distribution of statements across the four categories used in the coding.

FIGURE 5 ABOUT HERE - mean number of statements:

Mann-Whitney tests were conducted on the data to explore differences in categories of statement. There was no difference between the groups in terms of the proportion of statements that related to *modus operandi.* There was a significant difference in statements relating to Objects for the Office ($U = 5.5$, $p = 0.041$) (but not for the Lounge). There is also a significant difference in references to evidence in both scenes (for the Office $U = 3$, $p = 0.015$; for the Lounge $U = 0$, $p = 0.002$). Finally, there was no difference between groups in terms of Scene.

Video Analysis

An initial contrast can be drawn between the number of objects that were 'checked' by the Students (overall mean = 135) and by CSEs (mean = 48). Thus, the students made almost three times as many 'checks' as the CSEs (see figure 6). This contrasts with the average number of statements made (which were similar for the two groups), but also points to the difference in groups in terms of number of Objects mentioned by Students and CSEs.

FIGURE 6 ABOUT HERE – mean number of objects checked

Mann-Whitney U tests were used to compare the groups. For the Office search, Students checked significantly more objects than the CSEs for the Office ($U = 3$, $p = 0.015$) and for the Lounge ($U = 0.5$, $p = 0.002$). Within groups, there was no difference in the number of objects checked by students across the two scenes ($U = 10$, $p = 0.24$), but there was a differences for CSEs ($U = 3$, $p = 0.015$) who checked more objects for the Lounge.

Conclusions

The results indicate differences in strategy between expert and novice crime-scene examiner. While the Office was examined in similar times by the two groups, the Lounge had longer search time for the students. One explanation for this difference could lie in the conspicuity of evidence in the two scenes: the Office had footwear marks on the floor and scattered components, whereas the Lounge had limited disruption and conspicuous evidence. Thus, there was some ambiguity in this Lounge scene, which seemed to confuse the students and led to them spending longer in their examination. The CSEs searched both scenes in similar times, regardless of the number of Objects checked.

Second, the verbal protocols of the two groups indicate some differences in diagnostic activity. While both groups developed a theory of the *modus operandi*, in terms of likely actions being performed, there was little difference in the proportion of statements devoted to this by the two groups. Conversely, the students had a tendency to report significantly more objects in the scene than the CSEs, which is taken to imply a broad, high-level sampling of the scene. This was further demonstrated by the number of objects 'checked' by the students. The CSEs, on the other hand, reported significantly more objects that could be used as evidence, which is taken to imply a focus on subsequent analysis and investigation. One could interpret this as indication that the CSEs were being selective in their focus on objects and would only pick those objects which could play a role in the investigation, because they had the potential to yield evidence.

Discussion

The study explored three hypotheses centered on the cognitive processes of CSEs. For the first hypothesis was that the CSEs would differ from Students in their ability to target their

search on specific Objects. This implies differences in *framing*, which is similar to the ways in which the problem solving literature sees elements of a problem being used by experts and novices in different ways. Thus, in medical diagnosis, experts generate a small number of working hypotheses (Joseph & Patel, 1990; Kassirer & Gorry, 1978; Patel et al., 1994) and use heuristics to structure the problem-space (Gale & Marsden, 1983; Groves, 2008; Medin & Edelson, 1988). For the Students, the scenes were packed with Objects that could be related to a crime, but for the CSEs the scenes contained Objects that might yield recoverable evidence.

The second hypothesis was that the CSEs would seek to complete the search in less time than the Students. Not only were the CSEs faster than Students in completing the search but were also consistent across scenes and focussed attention on fewer objects. This reflects the fact that experts tend to focus their attention on *relevant* cues from a case history (Joseph & Patel, 1990). However, expert CSE might seek to complete an initial search in a limited period of time because they know that they will have to spend time collecting and recording evidence and producing a report before moving on the next job, and this might have a bearing on their decisions as to how many objects to examine (Smith et al., 2008).

The third hypothesis was that the CSEs would be better able to recognize evidential value than Students. The primary differences seem to lie, less in the appreciation of *modus operandi* so much as in the definition of evidence and how it might be subsequently processed (although the differences in numbers of Objects checked by the CSEs checked in the Lounge, compared with the Office, could suggest that the less obvious the *modus operandi*, the more effort could be put into examining the scene). Broadly, it is suggested that the students viewed the crime scene as a place in which a crime had been committed, and

spent their time considering the nature of the *crime* and the impact that this activity had on the objects in the scene (as indicated by the focus on Objects in their verbal protocols which, indicates a focus on the *potential* for Objects to be relevant to the investigation). In contrast, the CSEs used their understanding of the prosecution of the *criminal* to help decide which objects would be appropriate to recover for subsequent analysis (as indicated by the focus on Evidence in the CSE's verbal protocols). Thus, both the novice and expert 'saw' the rooms as places in which crimes had been committed, but the experts considered this as an initial stage of the process of criminal investigation (seeking to answer the question 'what useful evidence can be recovered?') while the students considered it more as a final state of the investigation (seeking to answer the question 'what happened here?'). This shows how expertise represents an adaptation to environmental and task demands (Ericsson & Lehman, 1996), in that the accrued experience of the expert CSEs from many similar scenes influenced their search strategy and ability to attend to specific cues, and that experts are better at making inferences about the state of the environment under scrutiny (Cellier, Eyrolle & Marine 2001; Ericsson & Smith, 1991); in terms of the selection of 'good' places to recover evidence) and are better than novices in anticipating future trends in the process (particularly in terms of the subsequent analysis of recovered material).

Implications for Training

Understanding differences between novice and expert Crime Scene Examiners has the potential to steer education in this field. In this section we briefly highlight how our findings can guide further research in support of training for CSEs. First, a long line of research shows how expertise develops in terms of 'deliberate practice' (e.g., Horn & Masunaga, 2006). It is only through deliberate practice, coupled with early feedback and the construction of goals, that

focused development can occur. Our research has helped to identify potential differences in search strategy between the novice and expert, suggesting ways for providing feedback that encourages reflection on the meaning of 'evidential value' and the likely analysis that could be applied to an item of evidence. This allows instructional staff to provide advice to learners as they begin the assessment stage of the examination. This is arguably the most important stage as it impacts significantly on the examination strategy and ultimately the collection of exhibits for forensic analysis. In a learning environment, it opens up opportunities for instructional staff to question learners on the value of specific types of forensic evidence and the associated evidential weighting.

An additional benefit to training, from exploring differences between novice and expert CSEs, is illumination of the process referred to as "Professional Judgment". In particular, Weston (2004), in his account of what skills are needed by Crime Scene Examiners, makes specific mention to "Professional Judgment". But little explanation is provided as to what this is or how it is indeed developed. Our findings, whilst preliminary, begin to illuminate this concept and show that it is possible to postulate that three key elements are needed to begin to expose where these difference are and how to created training that stimulates the development of expertise in Professional Judgment. First, the simulated environment needs to be sufficiently resourced with background items to challenge the relevance of the objects within its space. Second, the type of forensic samples distributed within the environment need to have varying levels of evidential value in line with the scenario. Third, instructional staff need to be aware of the types of factors comprising expert performance we have helped to identify in order to implement training that promotes development. Conversely allowing

experts to reflect on their crime scene assessment and examination is also useful in order to develop their own skills.

Précis

This study of crime scene examination suggests that expertise relates less to making inferences about the scene *per se* and more to considering evidence recovery and analysis, which are key to prosecution and which could be taken to support the ability to anticipate future trends in the process.

Key Points

1. In comparison with novices, expert Crime Scene Examiners will pay more attention to the evidential value of objects in a crime scene, and use this to frame their search.
2. Both novice and expert Crime Scene Examiners will use the *modus operandi* that they infer a criminal will have used to make sense of the scene.
3. The expert Crime Scene Examiner situates their work in the context of the broader criminal investigation process, for example, in considering how the material that they recover could be used by other investigators.

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Authors' Biographies

Chris Baber gained a BA(Hons) in Psycholgy / English at Keele University in 1987 and a PhD in Speech Technology at Aston University before joining the University of Birmingham in 1990. He originally joined the University of Birmingham to lecture on the MSc Work Design and Ergonomics course and then, in 2001, moved to the School of Electronic, Electrical and Computer Engineering (where he is currently Head of School). He was promoted to Reader in Interactive Systems Design in 2004 and Chair in Pervasive and Ubiquitous Computing in 2008. His research focuses on the potential Human Factors issues related to sensor-based and mobile technology for field-work.

Mark Butler is a former Assistant Senior Scenes of Crime Officer with Leicestershire Constabulary and has experience in a wide spectrum of criminal investigations from volume crime right through to serious and organised crime, including murder and terrorist investigation. In 2003 he subsequently took up a position at the National Training Center (now National Police Improvement Agency) as a Crime Scene Instructor. During his two and a half years as an instructor he spent a period of time as a Team Leader responsible for initial Crime Scene Training. Mark is a member of the Institution of Fire Engineers with Fire Investigation being a particular interest of his. He has been a Senior Lecturer in Crime Scene Science for the last 2 years at the University of Teesside and is due to start a project examining the expertise of Crime Scene Investigators.

Table 1

Coding of Extract of Verbal Protocol

Coding	**Total**	**Content**
Modus Operandi	4	…Identifying the point of entry …I can see damage …How would I actually get into this window, what would I hold onto …Consistent with someone climbing us onto there
Objects	0	
Evidence	2	…Skid footwear mark …Photograph the outside of this (.) point of entry
Scene	1	Something's been covered over with…erm…plastic