Distributed Cognition at the Crime Scene

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Distributed cognition at the crime scene

Chris Baber

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Abstract The examination of a scene of crime provides both an interesting case study and analogy for consideration of Distributed Cognition. In this paper, Distribution is defined by the number of agents involved in the criminal justice process, and in terms of the relationship between a Crime Scene Examiner and the environment being searched.

1 Introduction

The examination of a crime scene is subject to all manner of legal, ethical and scientific imperatives, and the evidence collected will be subjected to inspection by a variety of individuals with different intentions, skills and knowledge. In this paper, I will suggest that Crime Scene Examination presents an interesting and challenging domain in which to consider the notion of Distributed Cognition for the simple reason that it is not always apparent where the act of 'cognition' is situated. The ultimate aim of the criminal justice process, of course, is to acquire evidence which can be combined with information from other sources in order to produce a case that can be tried in Court. Contrary to its representation in popular fiction, the examination of a crime scene is unlikely to yield evidence that immediately links a suspect to a crime. Rather, the collection of evidence is part of a complex web of investigation that involves many individuals, each considering different forms of information in different ways. Thus, the paper begins with a cursory description of the role of the Crime Scene Examiner (CSE) within the criminal justice process.

The CSE is part of a much larger investigative system, each member of which has their own skills and roles (Smith et al. 2008). In a sense, Crime Scene Investigation involves sets of ad-hoc teams pursuing independent goals with quite limited overlap (Smith et al. 2008). Thus, there is typically a demarcation between roles. Having said this, the nature of this demarcation has been subject to significant shifting over the years, with the ongoing digitisation of Crime Scene Examination leading to further changes. For example, there used to be a specific role of Crime Scene Photographer whose function was to capture and process images of the crime scene (either prior to evidence recovery or at stages during the recovery process, depending on the nature of the crime). However, with the growing use of digital cameras by CSEs, this role has (in some Police Forces) changed. This has the interesting implication that the function of a photograph taken by the Crime Scene Photographer was to capture the scene as clearly as possible in order to aid discussion of the scene in Court (or during subsequent investigation), but the function of a photograph taken by the CSE *could* be to illustrate the evidence recovery process; I suggest this because the capturing of images by the CSE is *part* of the activity being undertaken rather than the sole focus of the activity. Whether or not similar changes might arise in terms of specialised analysis of fingerprints, footwear marks, DNA and other evidence is a matter of continued debate. For the time being, these analyses are generally performed by Forensic scientists rather than by CSEs. This means that one of the primary roles of the CSE is the recovery of evidence and its transportation in a usable state to the laboratory of the Forensic scientist. How this recovery and transportation is performed, and how closely the Forensic

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scientist and CSE cooperate depends very much on the nature of the crime being examined. For much of our work, we have focused on what is called ‘Volume Crime’ (e.g., robbery, burglary), as opposed to ‘Serious Crime’ (e.g., murder, rape, kidnapping). In Volume Crime, it is likely that the recovered evidence is passed onto the Forensic Scientist via a third party (sometimes called the ‘Evidence Manager’). This means that any information pertaining to that item needs to be carefully and comprehensively recorded by the CSE prior to depositing with the Evidence Manager. It is this combined process of recovery, storing, labelling and transportation of evidence that forms the basis of several forms of computer-based CSE support (i.e., evidence management systems). Before exploring this further, we consider the archetypal detective and his approach to investigating crimes.

2 Sherlock Holmes and reasoning about crime

Sherlock Holmes tells a visiting stranger “You have come up from the South–West I see” observing that the “…clay and chalk mixture which I see upon your toes caps is quite distinctive.” (Doyle 1989, p. 176, *The five orange pips*). This ability to draw correct conclusions from visual evidence is one of the hallmarks of Holmes’s powers, and implies a particular form of reasoning. Holmes’s method is a form of *induction* which involves the careful observation of the environment in order to develop hypotheses and then performing a process of elimination among a number of alternative possibilities, that is, “…eliminate all other factors, and what remains must be the truth.” (Doyle 1989, p. 66, *The sign of four*). So that, “one simply knocks out all the central inferences and presents one’s audience with the starting-point and the conclusion, [so that] one may produce a startling, though possibly a meretricious, effect.” (Doyle 1989, p. 583, *The adventure of the dancing men*). He would often present his conclusions as the result of deduction (i.e., ‘Elementary, my dear Watson’) and imply that he was able to draw a conclusion from general principles to a specific observation; indeed, Holmes would often refer to his method as *deduction*. One could argue that Holmes was attempting to apply a deductive method (through his exposition of premises) but was hampered by Doyle’s insistence of continuing to add extra pieces of evidence, which forced him into an inductive method.

This distinction between induction and deduction is based on a broad characterisation of the approaches as rival positions, namely induction as ‘observations leading to theory’, and deduction as ‘theory guiding observation’. In reality it can be difficult to separate the two, and difficult to conceive of the ‘pure’ application of induction (which would involve the compiling of observations in a manner which was theoretically agnostic, and the subsequent development of a theory which was *solely* based on those observations). One would assume that observations will be, in some sense, selective and that this selectivity could be tuned by attention to specific aspects of the environment. The point of this discussion is to raise a key issue for Crime Scene Examination; there is a supposition that the work of the CSE involves the ‘harvesting’ of materials which would then be analysed by Forensic Scientists. CSEs are supposed to maintain neutrality in terms of collecting evidence and to conduct their work in an inductive manner, because any sense in which they are interpreting the scene could be construed as a potential for bias in the investigation. Of course, Holmes never had to face such accusations because, as a literary character, he was not guilty of bias (only of revealing the information given to him by his author) and did not have to justify his interpretations under cross-examination in Court. The question of how Crime Scene Examination treads the line between induction and deduction is explored later in this paper; before this we will consider the notions of Distributed Cognition that underlie our studies.

3 Distributed cognition

The notion that cognition can be ‘distributed’ has been developed over the past couple of decades (Artman and Waern 1999; Artman and Garbis 1998; Busby 2001; Flor and Hutchins 1991; Furness and Blandford 2006; Hollan et al. 2002; Hutchins 1995a, b; Hutchins and Klausen 1998; Perry 2003; Rogers and Scaife 1997). While I suggest that Crime Scene Examination necessarily involves several agents performing cognitive activity, this is not to argue that this results in an ‘extended mind’ across these agents; as Dror and Harnand (2009) point out, to argue for an extended mind is analogous to arguing for extended migraine–just because an event occurs in one brain does not inevitably mean that other brains will share this event. Dror and Harnand’s (2009) argument is that one should not separate cognitive states from mental states. This criticism raises a core problem for the notion of ‘Distributed Cognition’, because it implies that cognition cannot be ‘distributed’ across agents because one cannot share mental states. A primary assumption of ‘Distributed Cognition’ is that it is not ‘cognition’ which is distributed so much as objects-in-the-world, which plays a role in supporting, structuring and aiding the activities of cognition. “A main point of departure from the traditional cognitive science framework is that, at the ‘work setting’ level of analysis, the distributed cognition approach aims to show how *intelligent processes in human activity transcend the boundaries of the individual actor*. Hence, instead of

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focusing on human activity in terms of processes acting upon representations inside an individual actor's heads the method seeks to apply the same cognitive concepts, but this time, to the interactions among a number of human actors and technological devices for a given activity." (Rogers 1997, p. 2). This quotation hints at two notions of an 'extended mind'. For example, some theorists claim that the mind can become 'extended' through its interactions with the environment, for example "…certain forms of human cognizing include inextricable tangles of feedback, feed-forward and feed-around loops; loops that promiscuously criss-cross the boundaries of brain, body and world." (Clark 2008, p. xxviii). Thus, as we shall in the section entitled 'Inspection and Examination', objects-in-the-world (and the representations made of them) form resources-for-action through their ability to afford specific responses. In addition, the crime scene examination process also features a distribution of tasks. What is particularly interesting, from the point of view of Distributed Cognition, is that the process of 'find–recover–analyse–interpret–conclude' is divided between two or more people, with quite limited communication between them. The CSE might perform the 'find-recover' tasks to gather potential evidence and then submit this for the 'analyse–interpret' tasks by a Forensic Scientist, who would then pass the results onto the Officer in Charge of the case with a probability to guide the preliminary 'conclude' tasks. The Officer in Charge would then combine this evidence with other information to raise a hypothesis and add this to a Case file which would be passed to the Crown Prosecution Service. This hypothesis, if maintained, would then be tested in Court by Barristers presenting a case for and against an individual.[1] Each step of this process would be documented and conclusions drawn in such a way as to avoid potential bias.

One could draw an analogy between 'extended mind' and the debate over 'broad' and 'narrow' mental content in Philosophy. The notion of 'narrow' content might assume that a person's belief about something could be defined entirely by their intrinsic characteristics (and would not change with any changes in their environment). The notion of 'broad' content, on the other hand, is inextricably tied to the person's environment. For example, Putnam (1975) contrasted beliefs about the concept 'water' between Earth and 'Twin Earth'. Twin Earth was exactly the same as Earth, with the exception that the chemical properties of that element termed 'water' were different (although the observable properties were the same on Earth and Twin Earth). Putnam's (1975) claim was that, given identical individuals on Earth and Twin Earth, when either spoke about 'water' they would be referring to something different. This means that the intrinsic characteristics of these two identical individuals would not be sufficient to determine the meaning of the word 'water', but that there needs to be some reference to external environment. This leads Putnam (1975) to make the well-known assertion that "…meanings' just ain't in the head." (p. 227).

Relating this discussion to the earlier contrast between Sherlock Holmes and contemporary CSE, we could suggest that Holmes represents the application of 'narrow' content; the world and its machinations exist solely through his (or rather, Doyle's) description of them and this description cannot be challenged (simply because the stories rarely include the opportunity to develop alternative explanations). In contrast, the CSE is involved in the application of 'broad' content; the world is represented as evidence which is passed between different people who can offer different interpretations to bear on it. From this perspective, the question becomes a matter of how representations are used rather than a matter of *individual* interpretation (because these interpretations will always, in an adversarial legal system, be open to dispute).

4 Distributing examination

While Sherlock Holmes provides an entertaining version of logical analysis (and serves as a template for contemporary television equivalents), his approach has many differences with modern Crime Scene and Forensic Examination. Obviously, Crime Scene Examiners do not have the benefit of the omniscient author guiding the discovery and interpretation of evidence, nor do they have the opportunity to present their findings to an informal (usually incredulous) gathering of people, as could Holmes. More importantly, Holmes's form of inductive reasoning requires the probabilistic elimination of competing hypotheses to explain a well-defined piece of evidence. The notion of a well-defined piece of evidence concerns the relationship between recognising something as having potential evidential value and the interpretation of that evidence in terms of other information. For Holmes (and his modern, fictional counterparts), this all takes place in the head of one person; so the processes are typically assumed to involve the mental states of a single individual.

Crime Scene Examination can be considered 'distributed', in a trivial sense, in that several people are involved in the interpretation of evidence, each providing a particular perspective on this interpretation. What we see in Sherlock Holmes is a literary representation of the many-headed being of the criminal justice process in the body of a single individual. As crime scene examination grew increasingly 'scientific' so the division of tasks into

[1] This example follows the legal system in England and Wales; while other countries will follow different processes, the point is that several people are involved in the interpretation of evidence.

discrete specialisms (each with a defined skill set) developed (Horswell 2004). Thus, it is typical for the Crime Scene Examiner and Forensic Scientist to have followed different career paths and have different skill sets (and, furthermore, for there to be a growing variety of specialisms within Forensic Science). Two further factors in the 'distribution' of Crime Scene Examination arise from the 'civilianisation' of CSE activity (the recruitment of personnel to this function from outside the Police Force) and the establishment of specific CSE units (outside the operation of separate Police stations). Each of these factors can be related to imperatives of economic and efficiency gains, but they have a bearing on how knowledge of criminal behaviour is shared and applied. For example, an understanding of criminal behaviour, gained over years of policing, could help interpret evidence; but recruiting civilian staff to these posts might remove the opportunity to gain knowledge and experience from policing. This could be dealt with through the training and exposure of new CSE personnel, or through the integration of CSE activity with other police activity. This relates to the second point, namely the removal of a CSE from local police stations to centralised services, which implies the need for a means of sharing experiences and knowledge. Thus, if there is a set of similar cases in an area (say a string of burglaries with similar ways of gaining access to a building), then one would expect a link to be made between them. However, if each case is investigated by different individuals, then it might not always be possible to explore such links.

What is happening in Crime Scene Examination is the mediation of cognition through the collection, manipulation and dissemination of a variety of artifacts; each artifact is interpreted in particular ways by the agents who come into contact with it. My argument will be that, for the various agents involved in this evidence chain, each artifact can 'afford' a particular set of responses, that is, the artifacts are resources for action, and the actions will be recognised by different agents according to their training and experience. I am using the notion of 'afford' in the sense introduced by Gibson (1977, 1979), as a form of perception–action coupling in which the physical appearance of an object in the world supports particular physical responses (e.g., a pebble 'affords' grasping in the hand). Thus, the design of artefacts that are used in a work environment become changed by their use, and these changes provide cues for subsequent use (Bang and Timpka 2003; Nemeth 2003; Seagull et al. 2003). What makes this a challenging domain for discussing Distributed Cognition is that the manipulation of an artifact by one agent might have a significant bearing on the state of the artifact, which could interfere with the activity of other agents, e.g., a simple example would be the need to preserve a crime scene so as to protect evidence from contamination conflicting with the need to retrieve specific items of evidence, or the need to dust a surface to reveal fingermarks conflicting with the need to photograph the scene.

5 Inspection and expectations

In their study of Crime Scene Examination, Schraagen and Leijenhorst (2001) recorded verbal protocols of the examination of a staged crime scene. They suggested, for the analysis of these protocols, that the experienced Crime Scene Examiner develops a narrative of the crime, for example considering how a person might have gained access to the building, what path they might have followed, what actions they might have performed, etc. This narrative would probably be intertwined with the search activity, such that the narrative would influence the search and the search would influence the narrative. In a similar vein, Ormerod et al. (2008) suggest that "…expert investigators … [call] … upon internalized cognitive frames relating to human behaviour that allow them to generate expectations about the actions and responses of others in real time." [Ormerod et al. 2008, p. 82].

In studies using ASL MobileEye, a head-mounted eye-tracking system, we asked Crime Scene Examiners to inspect a set of staged crime scene. In one study, we compared performance of three experienced Crime Scene Examiners and three Undergraduate students to search the same room under the same conditions. Of the many obvious and striking differences between the two sets of recordings, we noted that the students had a tendency to search only around locations that they believed to have links with stolen items–and so their narrative was focused solely on the loss of objects. The Crime Scene Examiners had a far more detailed narrative to guide their search and, as the stills from one recording shown later illustrate, spent a substantial part of their time looking at the door and noting possible evidence that could be recovered, e.g., blood stains near the latch, tool marks made by a chisel on the door frame, a footprint on the outside of the door.

Discussion with the Crime Scene Examiners showed how experience played a key role in deciding where to look for evidence and how best to examine the scene. For volume crime, the Crime Scene Examiner might walk the scene with the victim in the first instance, and then return to key locations to look for possible evidence. There was some debate as to what should be the first location to search. Standard practice might say that one begins with the Point of Entry and examines that thoroughly. In Fig. 1, the Point of Entry involved forcing an office door, possibly with a tool that had a sharp end, such as a chisel, which resulted in cuts around the latch. Fingermarks on the door could have been left during entry (or exit) and suggest that

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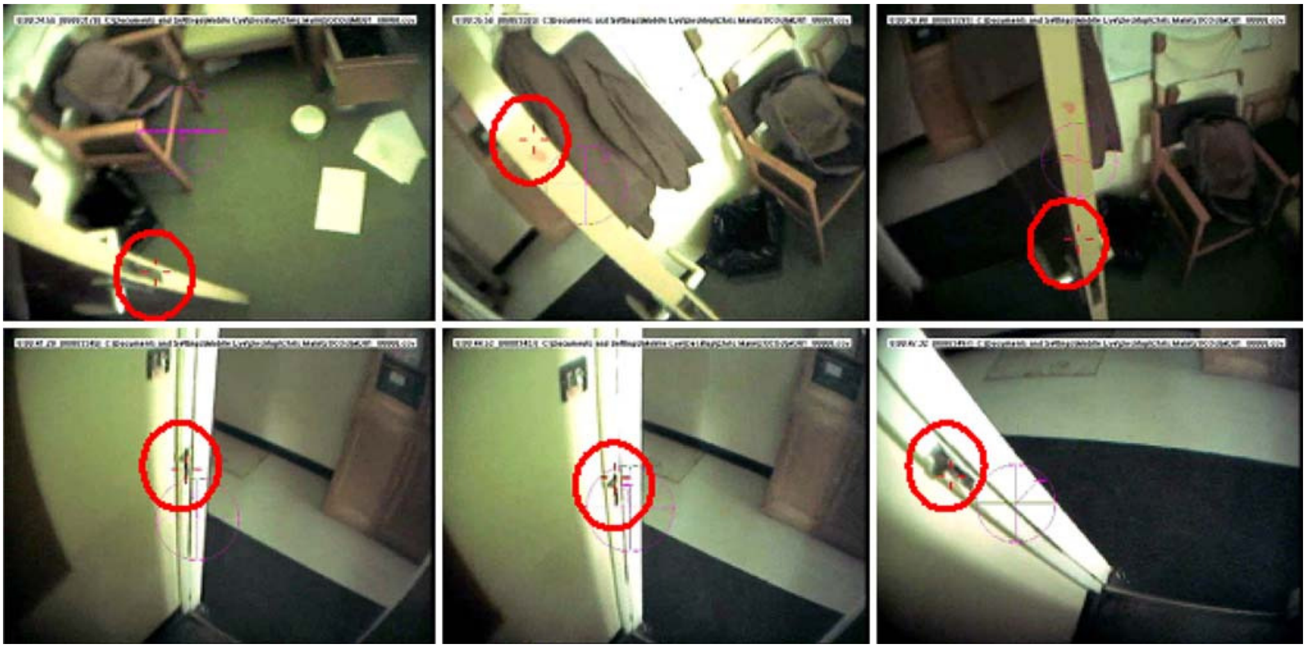

Fig. 1 Stills taken from mobile eye-tracker worn by Crime Scene Examiner inspecting a staged break-in (fixation indicated by *cross* in *thick circle*)

the entrant had cut the right thumb. Comparison between experienced CSEs and the untrained Engineering students with *no* experience of CSE work showed clear distinctions in search pattern; whereas the students all walked into the room without looking at the door, the CSEs all spent around 20% of their total search time inspecting the door before proceeding to the rest of the room. There are two plausible explanations for this. The first is that this scene (which had been staged to replicate an office break-in) had conspicuous evidence on and around the door. However, this evidence was not so conspicuous that the students noticed it. The second is that the CSEs expect to find evidence at Point of Entry and so attend to this in detail. The CSEs, after the study, stated that this approach was 'intuitive' and 'just felt right'. In their discussion of intuition in problem solving, Dreyfus and Dreyfus (1986) noted that "intuition is the product of deep situational involvement and recognition of similarity…; [and becomes expertise when] not only situations but also associated decisions are intuitively understood." (Dreyfus and Dreyfus 1986, p. 18). This notion is analogous to Klein's notion of Recognition-Primed Decision-making (Klein et al. 1986). In Recognition-Primed Decision-making (RPD), one can infer three broad approaches that the decision-maker might follow; (i) the situation is recognised as 'typical' and an associated set of activities would be brought to mind; (ii) the situation is defined in terms of core features, each of which would be developed in terms of (i); and (iii) the situation is unusual, and the person might mentally explore alternative strategies prior to committing to a set of activities. This study, and discussion with the Crime Scene Examiners, implies that the situation was defined in terms of (ii), and that each aspect would be considered in terms of a set of activities. The Point of Entry was explored in terms of recoverable DNA, fingermarks, and toolmarks (possibly in this order because each might be considered to have different levels of permanence and need to be recovered quickly). In a similar manner, Flin et al. (2007) have suggested that operational policing involves recognition of situations and the subsequent elicitation of appropriate response scripts, so this example of CSE suggests a three-step process by which a set of 'typical situations', such as Point of Entry, are used to guide search of a scene, which then leads to attention to items of potential evidential value, and then interpretation of these items. Thus, we could reverse Klein's RPD to describe the activity of the CSE as Decision-Primed Recognition. This is not a huge step in terms of Klein's notion of RPD because it simply follows the perception–action cycle that RPD implies: The recognition of features in the environment are responded to in terms of decisions based on previous experience, and these decision, in turn, can help shape expectations of what to look for in the environment (and to help interpret what one is looking at).

A second study concerned compared first students on a crime scene examination and forensics degree and experienced crime scene examiners. In one condition, there was a search of a ransacked office (again the scene was staged). Figure 2 shows a set of stills taken from an experienced Crime Scene Examiner opening the office door and

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Fig. 2 Series of images from eye-tracking worn by experienced CSE inspecting a ransacked office

immediately noticing a black mark on the floor (a), closer inspection indicates that this is a footwear mark (b) and, during the course of subsequent searching a plastic bag is found under a table and a pair of shoes found in the bag–the shoes have a black substance on their sole and the tread looks similar to that in the footwear mark (c). The scene had been staged to look as if an opportunistic thief had broken into the office and stolen money from a petty-cash tin (which was left open on top of the desk). However, in a twist in the scenario, we had staged the scene to actually reflect an 'insurance job', that is, the office's owner had staged the crime to claim on his insurance for loss of cash, personal possessions and some computing equipment.

Most of the evidence in the scene could have been used to support the conclusion of an opportunistic crime, which was the conclusion of all five students and two of the CSEs. There were three crucial pieces of evidence which pointed to the alternative conclusion (the shoes, as shown in Fig. 2; the fact that the window looked to have been forced but with no obvious evidence of it being used as a point of exit, particularly as it was some 15' off the ground; the order in which the desk drawers had been opened[2]).

The stills in Fig. 2 show an additional aspect of the CSEs exploration of the scene. As well as being guided by their experience of likely places to search for evidence, they need to maintain a running commentary of recovered evidence so as to be able to compare subsequent finds. Interestingly, the two CSEs who did not link the shoes to the footwear mark had previously dismissed the marks as 'smudged' and 'not worth recovering'. This implies that the mark was no longer part of their running commentary, and so the potential value of the shoes was not explored. The question of how a 'running commentary' is developed and indexed during a search activity could be worth further investigation. Studies of Distributed Cognition demonstrate ways in which objects-in-the-world structure cognition. Often these objects-in-the-world are purpose-built to support specific cognitive activities, or are adapted from existing objects. Researchers would then either focus on the design of such objects, and their ability to support cognition or at ways in which activities result in the modification of objects. Crime Scene Examination represents a special case, in that the objects-in-the-world to which the person attends have been neither designed nor adapted to suit a specific cognitive activity. Rather, the objects have to be discovered by the person and then interpreted in terms of their relevance to the task of gathering evidence. In this manner, the tasks of discovering objects-in-the-world that could have evidential value can be considered a form of recognition-primed decision-making.

6 Evidence recovery

As mentioned previously, one requirement of Crime Scene Examination is to select items that *could* be of evidential value. This means not only finding visible items, but also preparing surfaces so that less visible, or latent, items can be revealed. Figure 3, for instance, shows how a surface can be prepared to lift fingerprints. In this instance, the item being inspected (a glass bottle) is being dusted with aluminium powder using a brush. The brush is applied to the item using a swirling motion to ensure a light, even coverage. The process involved a period of brushing (for around 10 s), followed by a visual check (for about 5 s in which the bottle was gently rotated to catch light falling on any revealed marks), and then a repeated period of brushing prior to the use of tape to lift the revealed marks (or, more recently, the use of high-resolution digital photography to capture the marks) to transport them to the laboratory. In some instances, the visual check might be supplemented through the use of a handtorch which shone orthogonally to the powdered surface. In the inspection shown in Fig. 3, the torch was not used but the CSE could be seen to be rotating the bottle to catch available light

[2] In order to prevent one drawer obscuring the contents of the next, and in order to prevent the need to close drawers, the experienced criminal is likely to open drawers from the bottom up–but in this scene, we had obviously opened them top down.

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Fig. 3 Dusting for fingermarks

during the visual check phase. Concurrent verbal protocol during the search suggested that the CSE initially concentrated on two areas that were anticipated to reveal marks–and there was an assumption that each area would reveal different types of mark. Around the neck of the bottle, the search was initially for marks from fingertips and thumb holding the bottle vertically (as if carrying it) and around the middle of the bottle the search was for marks of the bottle resting across the middle of the fingers and being controlled by the thumb. Thus, a schema of how the bottle could have been used influenced the initial search.

While there are procedures in place for the recovery and analysis of finger marks, work by Dror et al. (2005) highlights how their interpretation could be biased with the provision of additional contextual information. In this study, contextual factors were manipulated by the story and photographs that were used to explain the source of the fingerprints, for example crimes with no physical harm to the person versus crimes with extreme physical harm. The study showed that in cases where the fingerprints were unambiguously different, there was little effect of context. When the fingerprints were ambiguous, namely when the certainty as to whether they were the same of different decreased, then the contextual factors seemed to play a role in increasing the likelihood of seeing a match. However, this effect was only observed for the context in which extreme physical harm featured in the background story. The study suggests that in cases where there might be some uncertainty as to whether fingerprints match and where the crime is extreme, that matching might be influenced by context. This also suggests that while the use of a narrative to guide the collection of evidence might be beneficial, it can also bias interpretation and, by implication, search. This raises the potential (and, perhaps, often unexplored) question of how recognition-primed decisions can become biasing rather than supporting, particularly in terms of expectancy bias. This also highlights the importance of maintaining as neutral a description in crime scene reports associated with recovered evidence as possible, and shows why the inductive approach is preferable for the CSE; even if the final 'theory' to which the evidence leads is not developed by the CSE but by other people in the criminal justice process.

7 Evidence Sharing

The preceding discussion implies that the search of a scene is guided by experience, expectation and the ability to recognise items of evidential value. In this respect, the notion of Distributed Cognition can be interpreted in terms of the use of objects in the world as resources-for-action. The Crime Scene Examiner recognises objects as resources-for-action which may well differ from untrained observers. For example, while the untrained observer might assume that a pane of glass in a window could yield fingermarks, they might be less inclined to immediately assume that it could also yield footwear marks, and still less inclined to recognise its potential for yielding DNA (the latter two could arise from someone climbing in through the window, or from pressing their forehead against the window to see if anyone is at home).

So far, this description looks very much like a process that involves the mental states of an individual; the CSE interprets the scene, recognising objects as resources-for-action, and then recovers the evidence. However, what makes the Crime Scene Examination process different from a Sherlock Holmes story is that the CSE submits the evidence for interpretation by other people. Indeed, it is unlikely for the CSE's notes and reports from the scene to include any deduction. Rather the report will be as descriptive as possible. This representation, of the scene and its evidence, is passed along the recovery train. So we have a set of processes that could ostensibly represent the stimulus (or input) to a cognitive processing system. This processing is (formally) undertaken by people other than the CSE.

Once evidence has been recovered, it is placed in appropriate bags (or containers), labelled and passed on the

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Forensic Laboratory for further analysis. This step in the process requires some means of maintaining accurate records of who has handled the evidence, as well as the accumulation of the results of analyses. This relates to a point made earlier, that the 'distributed' nature of the Crime Scene Examination process can make this process somewhat disjointed, in that it is not uncommon for the Forensic Scientist in the laboratory to have very little information on the item recovered. One could make a strong argument that this lack of information helps an analysis to be as objective as possible, by focussing only on the item at hand (and avoiding the potential for bias that Dror et al. (2005) demonstrated). On the other hand, it might be useful to have some knowledge of the item in situ, so as to decide how best to conduct analysis. If the Forensic Scientist had recovered the item herself then such information would be recalled by her, but when it is delivered in a batch of bags then such information is not obviously available. As an example of why this could be problematic, consider a finger-mark left on a window. This mark might not be detailed enough to form a print, but could indicate whether the window has been forced up or whether someone climbed down the window, knowing the orientation of the mark on the window can help decide how best to analyse it, but this might not have been provided in the evidence log.

8 Reporting and disclosure

In previous discussions of Crime Scene Examination, Baber et al. (2006a, b) consider the manner in which narratives are passed through the evidence chain. The argument was that different people in the evidence chain develop narratives (both formal and informal) that summarise the key aspects of their interpretation of the events and environment. Thus, a victim or witness might provide an account of the events as they recall; although, of course, the nature of eye-witness testimony is notoriously contradictory and prone to error (Wells and Olson 2003). Each account would develop a particular narrative, emphasising the aspects that the witness feels was relevant, and attempt to maintain an internal coherence and consistency (but which might differ from other accounts). Interviewing of suspects, in part, involves comparing different narratives (from the suspect versus a synthesis of the witness statements which maintains coherence and consistency). In this context, the role of forensic evidence becomes merely a tool to resolve any ambiguities in these accounts. However, of course, forensic evidence has become increasingly significant in investigations (to the extent that it is often given priority over narratives because of its assumed objectivity in comparison with the obvious subjectivity and potential for bias in the narratives). We propose that each step in the criminal justice process involves the production of narrative. There are the formal narratives that are structured by the reporting procedures and forms that are used to record investigations and analyses. This would lead to a set of reports, from Crime Scene Examiners and Forensic Scientists, which are written in a scientific style and which record details in as objective a manner as possible. Such narratives would then be subjected to scrutiny in Court in terms of the methods used to perform the analysis and the interpretation of the results. On the other hand, there are informal narratives that are passed on through discussion with agents involved in the investigation (say, between an attending officer and a victim, or between the attending officer and the crime scene examiner). These tend not to be recorded for several reasons. First, as discussed in the following paragraphs, Laws of Disclosure mean that anything which has a bearing on the case needs to be available to both Defence and Prosecution so as to maintain fairness and balance. Second, and perhaps more importantly, much of this informal narrative could be said to involve the development of formal narrative, e.g., an experienced attending officer might speak with a victim to calm or reassure them prior to taking a formal statement, and during this process the victim might have several partial accounts of what has happened but be seeking to reconcile this into a single.

The final decision of the relevance of an item of evidence is made in Court during the hearing. However, an initial assessment will be made (in the UK) by the Crown Prosecution Service which will evaluate the evidence that is being presented in support of a case and decide whether it is suitable. This raises one of the key dilemmas in evidence recovery and relates to the Laws of Disclosure. Basically, these Laws of Disclosure state that anything that has been collected as part of the investigation can be made available to both Prosecution and Defence (even if it is not presented at Court). This raises two issues for this discussion. First, the adversarial nature of the Justice System (in the UK and many other countries) means that the 'Distributed Cognition' involves not only cooperation and collaboration (in terms of several people contributing to a common goal) but also conflict (in terms of two parties attempting to prevent each other from achieving their goal). I am not sure that there are many other areas of distributed cognition research which come up against this problem (although, of course, one can imagine many examples from military and law enforcement). Second, the process often involves a number of different forms of analysis and interpretation. In Baber et al. (2006a, b), we referred to these forms as formal and informal narratives and suggested that there was a continual development of narratives, along several lines, over the course of an

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investigation and that very often these narratives might not connect.

9 Conclusions

In this paper, I suggest that, for Crime Scene Examination, cognition is distributed in three senses. First, there is the distribution of attention between the activities involved in searching, recovering and reporting. Second, there is the distribution of cognition between CSE personnel and the scene itself; the manner in which the scene is examined provides hints and cues to what evidence to recover, and interrupting this process (through the need to complete lengthy reports) could disrupt this process. For this activity, the environment and objects it contains become resource-for-action that the experience and training of Crime Scene Examiners allow them to interpret in ways which might be different to that of the untrained observer. Furthermore, the manner in which recovered items are passed from one person to the next in the evidence chain can modify the role of these items as resources-for-action; each step in the process interprets the information from the previous step in terms of additional knowledge and information. Third, there is the distribution of information between CSE personnel and other people involved in the investigation. The notion of formal and informal narrative, and their development through the criminal justice process, sees these narratives as additional resources-for-action.

A 'weak' view of the Distributed Cognition argument might claim that what is being distributed is the collection of objects upon which the act of cognition can be focused. This would require objects-in-the-world to play a fairly passive role in the process of cognition and for them to function as vehicles for the storage or representation of information. The artefacts allow users to off-load information (Scaife and Rogers 1996) and also a record of previous activity. In this version, the objects have their states altered by the actions that their users perform on them (e.g., through note-taking, folding or other markings). Furthermore, not only do these objects provide a means of recording and storing information, but their design affords (or influences) the actions of the person using them.

A 'strong' view of Distributed Cognition posits that it is the tasks involved in cognition which are being distributed. One way in which the activity of the CSE differs from some of these domains, is in the initial definition of objects-in-the-world, and for these objects to be 'revealed' in order to be recovered. This would regard the role of the CSE is primarily one of induction, or rather, as one of providing the set of alternatives upon which a process of induction could be applied. I would suggest that the act of induction takes place in the Court (or at least in the Crown Prosecution Service which decides whether a Case can be presented to Court). Prior to this act of induction, there are initial acts of deduction which are formally assigned to the Forensic Scientists, in their analysis and interpretation of evidence, but also informally applied by the CSE in the decision as to where to look and what to recover. In this view, one would expect agents and objects-in-the-world to be more active and capable of either performing, or at least participating in, information processing tasks. For example, Hutchins (1995b) famously speaks about the ways in which the flight-crew and their instruments work together to monitor the speed at which an aircraft is flying; his assertion is that this knowledge does not reside in the head of one specific individual, but is derived from the collection of information that is available in the cockpit. Perhaps, a point to note here is that, ultimately, there needs to be some 'cognizing entity' that is capable of combining the various bits of data into a coherent 'whole' and that this requires a set of mental capabilities that are uniquely human.

Both views raise questions that relate to the manner in which cognition becomes a matter of sharing tasks. In terms of distributed cognition, the work reported in this paper covers both the 'weak' and 'strong' views of distributed cognition. From the 'weak' view, it is argued that the training, knowledge and experience of Crime Scene Examiners allow them to use the environment and the artefacts within it, together with the collection of narratives through the criminal justice process, as resources-for-action in a manner that might be alien to the non-expert. In this way, the Crime Scene Examiner will not only search for specific artefacts but also be able to identify locations which could yield non-visible materials (e.g., places to check for fingerprints, DNA and other evidence). The use of eye-tracking and verbal protocol from crime scene examination shows how the approach to searching a scene differs with experience. From the 'strong' view, the reporting and interpretation of evidence from a crime scene through the criminal justice process implies a collective activity (which might not be coordinated by a central agency) that accumulates information to a point at which its interpretation can be tested in Court. While neither approach should be taken to imply that mental states are distributed across individuals, both imply that the action of one individual will form the basis for actions of the next. In this manner, the criminal justice process is able to 'know' the collected evidence, even though it is unlikely that a single individual will have access to all of the information collected during the examination.

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