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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.

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2 **Distributed cognition at the crime scene**

3 **Chris Baber**

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6 **Abstract** The examination of a scene of crime provides
7 both an interesting case study and analogy for consider-
8 ation of Distributed Cognition. In this paper, Distribution is
9 defined by the number of agents involved in the criminal
10 justice process, and in terms of the relationship between a
11 Crime Scene Examiner and the environment being
12 searched.
13

14 **1 Introduction**

15 The examination of a crime scene is subject to all manner
16 of legal, ethical and scientific imperatives, and the evidence
17 collected will be subjected to inspection by a variety of
18 individuals with different intentions, skills and knowledge.
19 In this paper, I will suggest that Crime Scene Examination
20 presents an interesting and challenging domain in which to
21 consider the notion of Distributed Cognition for the simple
22 reason that it is not always apparent where the act of
23 'cognition' is situated. The ultimate aim of the criminal
24 justice process, of course, is to acquire evidence which can
25 be combined with information from other sources in order
26 to produce a case that can be tried in Court. Contrary to its
27 representation in popular fiction, the examination of a
28 crime scene is unlikely to yield evidence that immediately
29 links a suspect to a crime. Rather, the collection of evi-
30 dence is part of a complex web of investigation that
31 involves many individuals, each considering different
32 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. 33 34

The CSE is part of a much larger investigative system, 35
each member of which has their own skills and roles 36
(Smith et al. 2008). In a sense, Crime Scene Investigation 37
involves sets of ad-hoc teams pursuing independent goals 38
with quite limited overlap (Smith et al. 2008). Thus, there 39
is typically a demarcation between roles. Having said this, 40
the nature of this demarcation has been subject to signifi- 41
cant shifting over the years, with the ongoing digitisation 42
of Crime Scene Examination leading to further changes. 43
For example, there used to be a specific role of Crime 44
Scene Photographer whose function was to capture and 45
process images of the crime scene (either prior to evidence 46
recovery or at stages during the recovery process, 47
depending on the nature of the crime). However, with the 48
growing use of digital cameras by CSEs, this role has (in 49
some Police Forces) changed. This has the interesting 50
implication that the function of a photograph taken by the 51
Crime Scene Photographer was to capture the scene as 52
clearly as possible in order to aid discussion of the scene in 53
Court (or during subsequent investigation), but the function 54
of a photograph taken by the CSE *could* be to illustrate the 55
evidence recovery process; I suggest this because the 56
capturing of images by the CSE is *part* of the activity being 57
undertaken rather than the sole focus of the activity. 58
Whether or not similar changes might arise in terms of 59
specialised analysis of fingerprints, footwear marks, DNA 60
and other evidence is a matter of continued debate. For the 61
time being, these analyses are generally performed by 62
Forensic scientists rather than by CSEs. This means that 63
one of the primary roles of the CSE is the recovery of 64
evidence and its transportation in a usable state to the 65
laboratory of the Forensic scientist. How this recovery and 66
transportation is performed, and how closely the Forensic 67

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

84 2 Sherlock Holmes and reasoning about crime

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

111 This distinction between induction and deduction is
112 based on a broad characterisation of the approaches as rival
113 positions, namely induction as ‘observations leading to
114 theory’, and deduction as ‘theory guiding observation’. In
115 reality it can be difficult to separate the two, and difficult to
116 conceive of the ‘pure’ application of induction (which
117 would involve the compiling of observations in a manner

118 which was theoretically agnostic, and the subsequent
119 development of a theory which was *solely* based on those
120 observations). One would assume that observations will be,
121 in some sense, selective and that this selectivity could be
122 tuned by attention to specific aspects of the environment.
123 The point of this discussion is to raise a key issue for Crime
124 Scene Examination; there is a supposition that the work of
125 the CSE involves the ‘harvesting’ of materials which
126 would then be analysed by Forensic Scientists. CSEs are
127 supposed to maintain neutrality in terms of collecting
128 evidence and to conduct their work in an inductive manner,
129 because any sense in which they are interpreting the scene
130 could be construed as a potential for bias in the investi-
131 gation. Of course, Holmes never had to face such accusa-
132 tions because, as a literary character, he was not guilty of
133 bias (only of revealing the information given to him by his
134 author) and did not have to justify his interpretations under
135 cross-examination in Court. The question of how Crime
136 Scene Examination treads the line between induction and
137 deduction is explored later in this paper; before this we will
138 consider the notions of Distributed Cognition that underlie
139 our studies.

3 Distributed cognition

140 The notion that cognition can be ‘distributed’ has been
141 developed over the past couple of decades (Artman and
142 Waern 1999; Artman and Garbis 1998; Busby 2001; Flor
143 and Hutchins 1991; Furness and Blandford 2006; Hollan
144 et al. 2002; Hutchins 1995a, b; Hutchins and Klausen 1998;
145 Perry 2003; Rogers and Scaife 1997). While I suggest that
146 Crime Scene Examination necessarily involves several
147 agents performing cognitive activity, this is not to argue
148 that this results in an ‘extended mind’ across these agents;
149 as Dror and Harnand (2009) point out, to argue for an
150 extended mind is analogous to arguing for extended
151 migraine—just because an event occurs in one brain does
152 not inevitably mean that other brains will share this event.
153 Dror and Harnand’s (2009) argument is that one should not
154 separate cognitive states from mental states. This criticism
155 raises a core problem for the notion of ‘Distributed Cog-
156 nition’, because it implies that cognition cannot be ‘dis-
157 tributed’ across agents because one cannot share mental
158 states. A primary assumption of ‘Distributed Cognition’ is
159 that it is not ‘cognition’ which is distributed so much as
160 objects-in-the-world, which plays a role in supporting,
161 structuring and aiding the activities of cognition. “A main
162 point of departure from the traditional cognitive science
163 framework is that, at the ‘work setting’ level of analysis,
164 the distributed cognition approach aims to show how
165 *intelligent processes in human activity transcend the*
166 *boundaries of the individual actor*. Hence, instead of
167

168 focusing on human activity in terms of processes acting
 169 upon representations inside an individual actor's heads the
 170 method seeks to apply the same cognitive concepts, but this
 171 time, to the interactions among a number of human actors
 172 and technological devices for a given activity." (Rogers
 173 1997, p. 2). This quotation hints at two notions of an
 174 'extended mind'. For example, some theorists claim that
 175 the mind can become 'extended' through its interactions
 176 with the environment, for example "...certain forms of
 177 human cognizing include inextricable tangles of feedback,
 178 feed-forward and feed-around loops; loops that promiscu-
 179 ously criss-cross the boundaries of brain, body and world."
 180 (Clark 2008, p. xxviii). Thus, as we shall in the section
 181 entitled 'Inspection and Examination', objects-in-the-world
 182 (and the representations made of them) form resources-for-
 183 action through their ability to afford specific responses. In
 184 addition, the crime scene examination process also features
 185 a distribution of tasks. What is particularly interesting,
 186 from the point of view of Distributed Cognition, is that the
 187 process of 'find-recover-analyse-interpret-conclude' is
 188 divided between two or more people, with quite limited
 189 communication between them. The CSE might perform the
 190 'find-recover' tasks to gather potential evidence and then
 191 submit this for the 'analyse-interpret' tasks by a Forensic
 192 Scientist, who would then pass the results onto the Officer
 193 in Charge of the case with a probability to guide the pre-
 194 liminary 'conclude' tasks. The Officer in Charge would
 195 then combine this evidence with other information to raise
 196 a hypothesis and add this to a Case file which would be
 197 passed to the Crown Prosecution Service. This hypothesis,
 198 if maintained, would then be tested in Court by Barristers
 199 presenting a case for and against an individual.¹ Each step
 200 of this process would be documented and conclusions
 201 drawn in such a way as to avoid potential bias.

202 One could draw an analogy between 'extended mind'
 203 and the debate over 'broad' and 'narrow' mental content in
 204 Philosophy. The notion of 'narrow' content might assume
 205 that a person's belief about something could be defined
 206 entirely by their intrinsic characteristics (and would not
 207 change with any changes in their environment). The notion
 208 of 'broad' content, on the other hand, is inextricably tied to
 209 the person's environment. For example, Putnam (1975)
 210 contrasted beliefs about the concept 'water' between Earth
 211 and 'Twin Earth'. Twin Earth was exactly the same as
 212 Earth, with the exception that the chemical properties of
 213 that element termed 'water' were different (although the
 214 observable properties were the same on Earth and Twin
 215 Earth). Putnam's (1975) claim was that, given identical
 216 individuals on Earth and Twin Earth, when either spoke

about 'water' they would be referring to something dif-
 ferent. This means that the intrinsic characteristics of these
 two identical individuals would not be sufficient to deter-
 mine 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 explana-
 tions). 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 inter-
 pretation 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 proba-
 bilistic 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 evi-
 dential 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 'distrib-
 uted', in a trivial sense, in that several people are involved
 in the interpretation of evidence, each providing a partic-
 ular 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.

267 discrete specialisms (each with a defined skill set) devel-
 268 oped (Horswell 2004). Thus, it is typical for the Crime
 269 Scene Examiner and Forensic Scientist to have followed
 270 different career paths and have different skill sets (and,
 271 furthermore, for there to be a growing variety of special-
 272 isms within Forensic Science). Two further factors in the
 273 ‘distribution’ of Crime Scene Examination arise from the
 274 ‘civilianisation’ of CSE activity (the recruitment of per-
 275 sonnel to this function from outside the Police Force) and
 276 the establishment of specific CSE units (outside the oper-
 277 ation of separate Police stations). Each of these factors can
 278 be related to imperatives of economic and efficiency gains,
 279 but they have a bearing on how knowledge of criminal
 280 behaviour is shared and applied. For example, an under-
 281 standing of criminal behaviour, gained over years of
 282 policing, could help interpret evidence; but recruiting
 283 civilian staff to these posts might remove the opportunity to
 284 gain knowledge and experience from policing. This could
 285 be dealt with through the training and exposure of new
 286 CSE personnel, or through the integration of CSE activity
 287 with other police activity. This relates to the second point,
 288 namely the removal of a CSE from local police stations to
 289 centralised services, which implies the need for a means of
 290 sharing experiences and knowledge. Thus, if there is a set
 291 of similar cases in an area (say a string of burglaries with
 292 similar ways of gaining access to a building), then one
 293 would expect a link to be made between them. However, if
 294 each case is investigated by different individuals, then it
 295 might not always be possible to explore such links.

296 What is happening in Crime Scene Examination is the
 297 mediation of cognition through the collection, manipulation
 298 and dissemination of a variety of artifacts; each artifact is
 299 interpreted in particular ways by the agents who come into
 300 contact with it. My argument will be that, for the various
 301 agents involved in this evidence chain, each artifact can
 302 ‘afford’ a particular set of responses, that is, the artifacts are
 303 resources for action, and the actions will be recognised by
 304 different agents according to their training and experience.
 305 I am using the notion of ‘afford’ in the sense introduced by
 306 Gibson (1977, 1979), as a form of perception–action cou-
 307 pling in which the physical appearance of an object in the
 308 world supports particular physical responses (e.g., a pebble
 309 ‘affords’ grasping in the hand). Thus, the design of artefacts
 310 that are used in a work environment become changed by
 311 their use, and these changes provide cues for subsequent
 312 use (Bang and Timpka 2003; Nemeth 2003; Seagull et al.
 313 2003). What makes this a challenging domain for dis-
 314 cussing Distributed Cognition is that the manipulation of an
 315 artifact by one agent might have a significant bearing on the
 316 state of the artifact, which could interfere with the activity
 317 of other agents, e.g., a simple example would be the need to
 318 preserve a crime scene so as to protect evidence from
 319 contamination conflicting with the need to retrieve specific

items of evidence, or the need to dust a surface to reveal
 fingerprints 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 obvi-
 ous 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 vol-
 ume 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

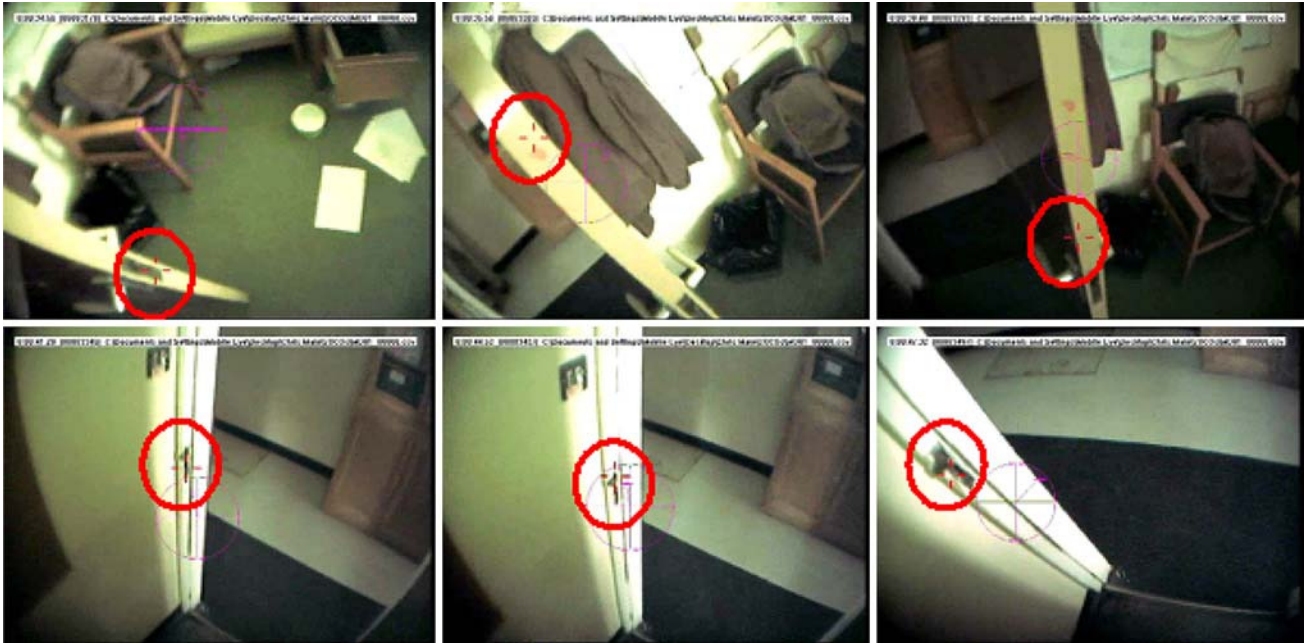


Fig. 1 Stills taken from mobile eye-tracker worn by Crime Scene Examiner inspecting a staged break-in (fixation indicated by cross in thick circle)

370 the entrant had cut the right thumb. Comparison between
 371 experienced CSEs and the untrained Engineering students
 372 with *no* experience of CSE work showed clear distinctions
 373 in search pattern; whereas the students all walked into the
 374 room without looking at the door, the CSEs all spent
 375 around 20% of their total search time inspecting the door
 376 before proceeding to the rest of the room. There are two
 377 plausible explanations for this. The first is that this scene
 378 (which had been staged to replicate an office break-in) had
 379 conspicuous evidence on and around the door. However,
 380 this evidence was not so conspicuous that the students
 381 noticed it. The second is that the CSEs expect to find
 382 evidence at Point of Entry and so attend to this in detail.
 383 The CSEs, after the study, stated that this approach was
 384 ‘intuitive’ and ‘just felt right’. In their discussion of intuition
 385 in problem solving, Dreyfus and Dreyfus (1986) noted that
 386 “intuition is the product of deep situational involvement
 387 and recognition of similarity...; [and becomes
 388 expertise when] not only situations but also associated
 389 decisions are intuitively understood.” (Dreyfus and
 390 Dreyfus 1986, p. 18). This notion is analogous to Klein’s
 391 notion of Recognition-Primed Decision-making (Klein
 392 et al. 1986). In Recognition-Primed Decision-making
 393 (RPD), one can infer three broad approaches that the
 394 decision-maker might follow; (i) the situation is recognised
 395 as ‘typical’ and an associated set of activities would be
 396 brought to mind; (ii) the situation is defined in terms of
 397 core features, each of which would be developed in terms
 398 of (i); and (iii) the situation is unusual, and the person
 399 might mentally explore alternative strategies prior to

400 committing to a set of activities. This study, and discussion
 401 with the Crime Scene Examiners, implies that the situation
 402 was defined in terms of (ii), and that each aspect would be
 403 considered in terms of a set of activities. The Point of Entry
 404 was explored in terms of recoverable DNA, fingerprints,
 405 and toolmarks (possibly in this order because each might
 406 be considered to have different levels of permanence and
 407 need to be recovered quickly). In a similar manner, Flin
 408 et al. (2007) have suggested that operational policing
 409 involves recognition of situations and the subsequent
 410 elicitation of appropriate response scripts, so this example
 411 of CSE suggests a three-step process by which a set of
 412 ‘typical situations’, such as Point of Entry, are used to
 413 guide search of a scene, which then leads to attention to
 414 items of potential evidential value, and then interpretation
 415 of these items. Thus, we could reverse Klein’s RPD to
 416 describe the activity of the CSE as Decision-Primed Recognition.
 417 This is not a huge step in terms of Klein’s notion
 418 of RPD because it simply follows the perception–action
 419 cycle that RPD implies: The recognition of features in the
 420 environment are responded to in terms of decisions based
 421 on previous experience, and these decision, in turn, can
 422 help shape expectations of what to look for in the environment
 423 (and to help interpret what one is looking at).

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



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

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

443 Most of the evidence in the scene could have been used
444 to support the conclusion of an opportunistic crime, which
445 was the conclusion of all five students and two of the CSEs.
446 There were three crucial pieces of evidence which pointed
447 to the alternative conclusion (the shoes, as shown in Fig. 2;
448 the fact that the window looked to have been forced but
449 with no obvious evidence of it being used as a point of exit,
450 particularly as it was some 15’ off the ground; the order in
451 which the desk drawers had been opened²).

452 The stills in Fig. 2 show an additional aspect of the
453 CSEs exploration of the scene. As well as being guided by
454 their experience of likely places to search for evidence,
455 they need to maintain a running commentary of recovered
456 evidence so as to be able to compare subsequent finds.
457 Interestingly, the two CSEs who did not link the shoes to
458 the footwear mark had previously dismissed the marks as
459 ‘smudged’ and ‘not worth recovering’. This implies that
460 the mark was no longer part of their running commentary,
461 and so the potential value of the shoes was not explored.
462 The question of how a ‘running commentary’ is developed
463 and indexed during a search activity could be worth further
464 investigation. Studies of Distributed Cognition demonstrate
465 ways in which objects-in-the-world structure cognition.

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.

466 Often these objects-in-the-world are purpose-built to sup-
467 port specific cognitive activities, or are adapted from
468 existing objects. Researchers would then either focus on
469 the design of such objects, and their ability to support
470 cognition or at ways in which activities result in the
471 modification of objects. Crime Scene Examination repre-
472 sents a special case, in that the objects-in-the-world to
473 which the person attends have been neither designed nor
474 adapted to suit a specific cognitive activity. Rather, the
475 objects have to be discovered by the person and then
476 interpreted in terms of their relevance to the task of gath-
477 ering evidence. In this manner, the tasks of discovering
478 objects-in-the-world that could have evidential value can
479 be considered a form of recognition-primed decision-
480 making.

6 Evidence recovery 481

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



Fig. 3 Dusting for fingerprints

Author Proof

503 during the visual check phase. Concurrent verbal protocol
 504 during the search suggested that the CSE initially concen-
 505 trated on two areas that were anticipated to reveal
 506 marks—and there was an assumption that each area would
 507 reveal different types of mark. Around the neck of the
 508 bottle, the search was initially for marks from fingertips
 509 and thumb holding the bottle vertically (as if carrying it)
 510 and around the middle of the bottle the search was for
 511 marks of the bottle resting across the middle of the fingers
 512 and being controlled by the thumb. Thus, a schema of how
 513 the bottle could have been used influenced the initial
 514 search.

515 While there are procedures in place for the recovery and
 516 analysis of finger marks, work by Dror et al. (2005) high-
 517 lights how their interpretation could be biased with the
 518 provision of additional contextual information. In this
 519 study, contextual factors were manipulated by the story and
 520 photographs that were used to explain the source of the
 521 fingerprints, for example crimes with no physical harm to
 522 the person versus crimes with extreme physical harm. The
 523 study showed that in cases where the fingerprints were
 524 unambiguously different, there was little effect of context.
 525 When the fingerprints were ambiguous, namely when the
 526 certainty as to whether they were the same of different
 527 decreased, then the contextual factors seemed to play a role
 528 in increasing the likelihood of seeing a match. However,
 529 this effect was only observed for the context in which
 530 extreme physical harm featured in the background story.
 531 The study suggests that in cases where there might be some
 532 uncertainty as to whether fingerprints match and where the
 533 crime is extreme, that matching might be influenced by
 534 context. This also suggests that while the use of a narrative
 535 to guide the collection of evidence might be beneficial, it
 536 can also bias interpretation and, by implication, search.
 537 This raises the potential (and, perhaps, often unexplored)
 538 question of how recognition-primed decisions can become
 539 biasing rather than supporting, particularly in terms of
 540 expectancy bias. This also highlights the importance of
 541 maintaining as neutral a description in crime scene reports
 542 associated with recovered evidence as possible, and shows

why the inductive approach is preferable for the CSE; even 543
 if the final ‘theory’ to which the evidence leads is not 544
 developed by the CSE but by other people in the criminal 545
 justice process. 546

7 Evidence Sharing 547

The preceding discussion implies that the search of a scene 548
 is guided by experience, expectation and the ability to 549
 recognise items of evidential value. In this respect, the 550
 notion of Distributed Cognition can be interpreted in terms 551
 of the use of objects in the world as resources-for-action. 552
 The Crime Scene Examiner recognises objects as resour- 553
 ces-for-action which may well differ from untrained 554
 observers. For example, while the untrained observer might 555
 assume that a pane of glass in a window could yield fin- 556
 germarks, they might be less inclined to immediately 557
 assume that it could also yield footwear marks, and still 558
 less inclined to recognise its potential for yielding DNA 559
 (the latter two could arise from someone climbing in 560
 through the window, or from pressing their forehead 561
 against the window to see if anyone is at home). 562

So far, this description looks very much like a process 563
 that involves the mental states of an individual; the CSE 564
 interprets the scene, recognising objects as resources-for- 565
 action, and then recovers the evidence. However, what 566
 makes the Crime Scene Examination process different 567
 from a Sherlock Holmes story is that the CSE submits the 568
 evidence for interpretation by other people. Indeed, it is 569
 unlikely for the CSE’s notes and reports from the scene to 570
 include any deduction. Rather the report will be as 571
 descriptive as possible. This representation, of the scene 572
 and its evidence, is passed along the recovery train. So we 573
 have a set of processes that could ostensibly represent the 574
 stimulus (or input) to a cognitive processing system. This 575
 processing is (formally) undertaken by people other than 576
 the CSE. 577

Once evidence has been recovered, it is placed in 578
 appropriate bags (or containers), labelled and passed on the 579

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

606 8 Reporting and disclosure

607 In previous discussions of Crime Scene Examination,
 608 Baber et al. (2006a, b) consider the manner in which nar-
 609 ratives are passed through the evidence chain. The argu-
 610 ment was that different people in the evidence chain
 611 develop narratives (both formal and informal) that sum-
 612 marise the key aspects of their interpretation of the events
 613 and environment. Thus, a victim or witness might provide
 614 an account of the events as they recall; although, of course,
 615 the nature of eye-witness testimony is notoriously contra-
 616 dictory and prone to error (Wells and Olson 2003). Each
 617 account would develop a particular narrative, emphasising
 618 the aspects that the witness feels was relevant, and attempt
 619 to maintain an internal coherence and consistency (but
 620 which might differ from other accounts). Interviewing of
 621 suspects, in part, involves comparing different narratives
 622 (from the suspect versus a synthesis of the witness state-
 623 ments which maintains coherence and consistency). In this
 624 context, the role of forensic evidence becomes merely a
 625 tool to resolve any ambiguities in these accounts. However,
 626 of course, forensic evidence has become increasingly sig-
 627 nificant in investigations (to the extent that it is often given
 628 priority over narratives because of its assumed objectivity
 629 in comparison with the obvious subjectivity and potential

630 for bias in the narratives). We propose that each step in the
 631 criminal justice process involves the production of narra-
 632 tive. There are the formal narratives that are structured by
 633 the reporting procedures and forms that are used to record
 634 investigations and analyses. This would lead to a set of
 635 reports, from Crime Scene Examiners and Forensic Sci-
 636 entists, which are written in a scientific style and which
 637 record details in as objective a manner as possible. Such
 638 narratives would then be subjected to scrutiny in Court in
 639 terms of the methods used to perform the analysis and the
 640 interpretation of the results. On the other hand, there are
 641 informal narratives that are passed on through discussion
 642 with agents involved in the investigation (say, between an
 643 attending officer and a victim, or between the attending
 644 officer and the crime scene examiner). These tend not to be
 645 recorded for several reasons. First, as discussed in the
 646 following paragraphs, Laws of Disclosure mean that any-
 647 thing which has a bearing on the case needs to be available
 648 to both Defence and Prosecution so as to maintain fairness
 649 and balance. Second, and perhaps more importantly, much
 650 of this informal narrative could be said to involve the
 651 development of formal narrative, e.g., an experienced
 652 attending officer might speak with a victim to calm or
 653 reassure them prior to taking a formal statement, and
 654 during this process the victim might have several partial
 655 accounts of what has happened but be seeking to reconcile
 656 this into a single.

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

683 investigation and that very often these narratives might not
684 connect.

685 9 Conclusions

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

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

723 A 'strong' view of Distributed Cognition posits that it is
724 the tasks involved in cognition which are being distributed.
725 One way in which the activity of the CSE differs from some
726 of these domains, is in the initial definition of objects-in-the-
727 world, and for these objects to be 'revealed' in order to be
728 recovered. This would regard the role of the CSE is primarily
729 one of induction, or rather, as one of providing the set of
730 alternatives upon which a process of induction could be
731 applied. I would suggest that the act of induction takes place
732 in the Court (or at least in the Crown Prosecution Service

733 which decides whether a Case can be presented to Court).
734 Prior to this act of induction, there are initial acts of
735 deduction which are formally assigned to the Forensic Sci-
736 entists, in their analysis and interpretation of evidence, but
737 also informally applied by the CSE in the decision as to
738 where to look and what to recover. In this view, one would
739 expect agents and objects-in-the-world to be more active and
740 capable of either performing, or at least participating in,
741 information processing tasks. For example, Hutchins
(1995b) famously speaks about the ways in which the flight-
742 crew and their instruments work together to monitor the
743 speed at which an aircraft is flying; his assertion is that this
744 knowledge does not reside in the head of one specific indi-
745 vidual, but is derived from the collection of information that
746 is available in the cockpit. Perhaps, a point to note here is
747 that, ultimately, there needs to be some 'cognizing entity'
748 that is capable of combining the various bits of data into a
749 coherent 'whole' and that this requires a set of mental
750 capabilities that are uniquely human.
751

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

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