Forensic Science International 262 (2016) 1–10

Contents lists available at ScienceDirect

Forensic Science International

journal homepage: www.elsevier.com/locate/forsciint

To analyse a trace or not? Evaluating the decision-making process in the criminal investigation

Sonja Bitzer [a,*], Olivier Ribaux [a], Nicola Albertini [b], Olivier Delémont [a]

[a] Ecole des Sciences Criminelles, Université de Lausanne, Batochime, CH-1015 Lausanne, Switzerland
[b] Police Cantonale Vaudoise, Service d'Identité Judiciaire Centre Blécherette, 1014 Lausanne, Switzerland

ARTICLE INFO

Article history:
Received 18 November 2015
Received in revised form 22 January 2016
Accepted 10 February 2016
Available online 18 February 2016

Keywords:
Forensic science
DNA analysis
Decision tree
Classification

ABSTRACT

In order to broaden our knowledge and understanding of the decision steps in the criminal investigation process, we started by evaluating the decision to analyse a trace and the factors involved in this decision step. This decision step is embedded in the complete criminal investigation process, involving multiple decision and triaging steps.

Considering robbery cases occurring in a geographic region during a 2-year-period, we have studied the factors influencing the decision to submit biological traces, directly sampled on the scene of the robbery or on collected objects, for analysis. The factors were categorised into five knowledge dimensions: strategic, immediate, physical, criminal and utility and decision tree analysis was carried out.

Factors in each category played a role in the decision to analyse a biological trace. Interestingly, factors involving information available prior to the analysis are of importance, such as the fact that a positive result (a profile suitable for comparison) is already available in the case, or that a suspect has been identified through traditional police work before analysis. One factor that was taken into account, but was not significant, is the matrix of the trace. Hence, the decision to analyse a trace is not influenced by this variable.

The decision to analyse a trace first is very complex and many of the tested variables were taken into account. The decisions are often made on a case-by-case basis.

1. Process and decision-making steps

The criminal investigation process needs to be considered as a whole, with the traces collected at the crime scene and the reconstruction (i.e. micro-sequence of events [1]) going back to the events at this same crime scene [2]. Kind [3] and Brodeur [4] suggest two similar models of the criminal investigation process. The latter has a more detailed view of the investigative phase, dividing it into a triplet of identification of the author of the crime, locating the suspect, concluding with structuring of the evidence. The former differentiates three "chapters": (1) the problem to find, (2) refinement, checking and preparation for trial, and, finally (3) the problem to prove. This distinction is mainly based on a difference in inferential reasoning within each "chapter" and gives rise to different ways of using traces. In the first "chapter", the logical process starts from the traces leading to the suspect(s), a mainly abductive approach. Whereas, once a suspect is apprehended, the reasoning process becomes mainly deductive, starting from the case in order to explain the occurrence of these particular traces. This distinction in different phases of the investigation contributes to the manifold roles forensic science plays in the criminal investigation process [5].

We propose to adopt a complementary perspective considering the practice of forensic science within the investigation process as a decision-making process. The complete process can be divided into several decision steps, some of which are closely linked or even intertwined. In our view, the following key decision steps should be recognised:

1. the decision to attend the crime scene and search for traces
2. the decision to collect traces
3. the decision to analyse traces
4. the decision to use traces in the inquiry
5. the decision to collate trace-related information in a structured database
6. the decision to use traces in court

* Corresponding author. Tel.: +41 21 692 46 21; fax: +41 21 692 46 05.
E-mail address: sonja.bitzer@unil.ch (S. Bitzer).

http://dx.doi.org/10.1016/j.forsciint.2016.02.022
0379-0738/

Before the search begins, the question of whether a crime scene investigator *attends a crime scene* or not has to be answered (point 1). A first and more often than not latent triaging step occurs already at this stage, as crime scenes that are not attended cannot be sources of traces, and thus, clues or evidence [6,7]. The first phase of the criminal investigation consists of the problem to "find", or rather, the search for traces (point 2). This search needs to be systematic, based on cognitive skills such as observation and understanding of the criminal and immediate environment and the traces [5,8]. This is another step that undergoes triaging; traces that are not known will not be looked for, detected nor collected. Hence, limiting the search for traces to only certain types of traces, excludes other types of traces from the investigation process. The result of the search of traces leads at best to their *detection*. In order to detect traces, the recognition as such is crucial. The detection of traces is not a decision step as such; there is no conscious decision-making regarding the detection of traces. However, the recognition of traces and their anticipation rely on cognitive abilities that are linked to personal skills, training and experience and these are factors influencing other decision steps. Then follows the *collection of traces*. Concerning visible traces, this decision is often based on the quality of the trace. A certain triaging is undertaken at this point, knowing, however, that you generally cannot go back to the crime scene at a latter point. This step concludes the crime scene investigation.

The next decision-making step is the question of whether to *analyse a trace* or not (point 3); this includes in-house treatment of traces (e.g. shoe marks, fingermarks) and submission to external laboratories (mainly for biological traces). One could argue that this decision is obsolete, as the collection of traces already serves as triaging step and the reason that a trace is collected is that it will be analysed and further exploited. For some traces this might be the case, or rather, the decision to analyse a trace is already anticipated at the moment of its collection. This would merely constitute a shift in the moment when the decision is made. However, in many cases, all collected traces are not analysed, or not all in the first instance. It is then necessary to decide which traces to analyse, even if it is the question of which traces to analyse first.

Using a trace, or rather a clue–the information gained from the trace by analysing it–in the investigation is closely linked to the question of whether to analyse a trace or not (point 4). An assumption is made that anticipating the use of a clue guides the decision to analyse a trace. Assuming this, the probability of obtaining a profile suitable for comparison (for the sake of simplicity, hereafter called "Positive result") will also influence the decision about which trace to analyse. Then follows the decision to *collate trace-related information in a structured database* in order to use the potential of this information for intelligence on criminal phenomena, repetitive crimes, etc. (point 5). This database is a representation of what is known, at a certain time, on the crime environment. This is why it is generally called the memory. It organises information on specific cases and on their relations in the perspective of making the best use of its potential for providing intelligence on repetitive crimes and crime problems. Indeed, beyond using traces in investigations, as a reaction to the occurrence of each single event (point 4), this information can also be used in more proactive style of policing. This means that traces contribute to the development of knowledge on crime problems (e.g. by aggregating cases through linking), allowing to anticipate further occurrence, and devise a global response. This is typical of intelligence-led policing framework [9,10]). The final step of the use of forensic science in the criminal justice process consists of its *use for court purposes* (point 6). In this context, constraints, reasoning, and decisions to be taken are of a very different nature. This is why the clues used in court are not necessarily the same as the ones that were used in the investigation. For instance, depending on legal systems, in the investigative phase, the standard that needs to be reached for the trace to be used as information does not need to be as high as when it has to be accepted for court.

The decision to analyse a trace, which is under scrutiny in this paper, is embedded in the described decision process. Understanding how this decision is made through determining which factors are involved in the decision to analyse a trace is the main objective of this paper and will be discussed first through a literature review. Subsequently, the methodology and data employed are specified and a model is suggested. Finally, the influencing variables are presented and discussed and tested through statistical analysis. This study has been undertaken in order to empirically determine which factors contribute to the decision to analyse a trace, and thus, raise questions about existing assumptions in the literature regarding effectiveness and efficiency as key drivers in decisions to analyse traces.

2. Factors affecting the decision to analyse traces

In several effectiveness measurement studies [11–13], the authors examined the contribution of forensic science at five different stages: crime scene attendance, evidence submission, analysis, identification, and arrest. They generally used success rates (in terms of number of cases where forensic evidence was present) and lead times as effectiveness indicators, and compared these indicators for fingermarks and biological traces. All or most of the filtering was done at the crime scene with the decision to collect traces, and (almost) 100% of these traces were then forwarded to the laboratory for analysis. Hence, no factors relating to the decision to analyse were studied in these organisational systems.

Often, strategic guidelines are established by policy makers, police or forensic managers. They are implemented through protocols and procedures for deciding which traces are analysed, stemming from financial and performance pressure [14]. These guidelines focus mainly on qualitative aspects of the trace: "rich" biological traces (blood, saliva, etc.) are preferably chosen for analysis over contact traces, especially in high-volume crimes [14]. However, when considering the case circumstances of these types of cases, "rich" biological traces are not the most recurrent traces, and also not necessarily the most promising in terms of utility (added value of information to the case, see [15]).

When police investigators were asked why they would use forensic science, the main reason given was to strengthen the case against a suspect [16–18]. Similarly, when asked about why traces were not submitted for analysis, the lack of a suspect was mentioned recurrently [19,20]. Furthermore, the presence of traces is not statistically significant for the arrest of a suspect, which is not surprising, as the studied group of crime scene investigators does not recognize the utility of the DNA database [16,21,22].

Ribaux et al. [7] proposed a deconstruction and formalisation of the first steps impacting on the decision process. In their model encompassing four environments, they outlined some of the factors that affect the first two decision steps preceding the analysis of a trace: the decision to attend a crime scene and to search for traces. The proposed model reunites the *strategic, criminal, physical and immediate* knowledge dimensions. These incorporate constraints on, and facilitators of, the decision steps, factors that either limit or promote attendance at the crime scene and the collection of traces. In our view, this model could be extended to the decision to analyse a trace. Indeed, some of the environments (i.e. the strategic and the physical environment) have already been mentioned to influence this decision, but such an holistic view has never been adopted. We suggest the addition of the *utility* dimension [15], which includes factors relating to information available to the decision-maker at the moment of the