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Factors leading to the involvement of Forensic Advisors in the Belgian criminal justice system

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ABSTRACT

Forensic Advisors at the National Institute for Criminalistics and Criminology in Brussels act as advising body to the magistrate regarding analytical possibilities and the usefulness of trace analysis in a case. Initially, their function was devised to assist in complex murder cases with unknown offender. However, in a previous study, the increasing diversity of the cases they are requested for has been observed (Bitzer et al., in press). In order to deepen our understanding of the decision steps in the criminal investigation process, the decision to involve a Forensic Advisor and the factors leading to their involvement were evaluated.

The study focused on homicide, robbery and burglary cases with and without requests for a Forensic Advisor between January 2014 and June 2016. The factors were categorised into five knowledge dimensions: strategic, immediate, physical, criminal and utility. Decision tree modelling was carried out in order to identify the factors influencing the request for a Forensic Advisor in the case.

The decision to request a Forensic Advisor differs between different types of offences. It also depends on the complexity of the case in terms of the number of traces and objects collected at the crime scene, and the availability of witness reports. Indeed, Forensic Advisors take the role of trace analysis coordinator by providing an overview of all available traces, objects, analyses and results. According to the principal implication factors and the performed case study, the contribution of Forensic Advisors consists mainly in summarising all information and advise on potential additional analyses. This might be explained by a loss of overview of the information and the possibilities regarding trace analysis by the magistrate responsible of the case.

1. Introduction

Forensic Advisors (FAs) at the National Institute for Criminalistics and Criminology (NICC) act as an advising body to the magistrate regarding the possibility and utility of trace analysis in a case [2,3]. It is conjectured that the FAs, due to their privileged position, base their decision on the utility of the clues in the investigation. Indeed, they can decide for or against an analysis [4], and hence, potentially choose only the most promising and useful traces to be analysed.

Although the concept of case coordinator already exists [5–7], this position at the NICC is unique in structure and the FA assists the prosecutor in complex criminal investigations regarding the analytical and investigative strategy. On the one hand, FAs are generalists in forensic science, in close contact with new developments and techniques. On the other hand, they are fully aware of the criminal case, as they often receive the complete criminal file. They act as bridge between the legal and the scientific environment, enabling and facilitating communication flow and updates.

In the initial project [8],[1] it was foreseen that FAs are to be consulted by magistrates in complex murder cases with unknown offender. Indeed, in a legal notice regarding DNA analysis, the involvement of FAs is stipulated along with the discussion with crime scene investigators. Their primary task was defined as aiding in triaging decisions regarding the processing of traces. Regarding the decision-making factors in the criminal investigation, a lack of knowledge exists [9]. Often triaging is either the responsibility of the laboratory personnel or the prosecutor. The latter is not necessarily familiar with the complete scope and applications of forensic science

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[1] Project of law modifying the criminal code and the law of 22 March 1999 regarding the identification procedure by DNA analysis in criminal cases.

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and the former is often deliberately kept apart from the context of the case (i.e. context bias, see Ref. [10]). Both are thus uninformed partners, deciding beyond their personal level of expertise [11]. The function of the FA was thus created to fill this gap.

As was shown in Bitzer et al. [1], the type of cases submitted to the FAs has changed over the years. As was suggested in the early project, complex cases constituted their main workload. However, since 2014, simple and review cases were also submitted to the FAs. In addition, the type of offence diversified. To homicide cases which remain their primary subject, mainly robbery, burglary and sexual assault cases were added. Although the workload has been ever-increasing and diversifying, no study has been undertaken thus far to investigate the factors leading to the involvement of FAs. Determining these factors could inform on the cases for which an expertise of the FAs could be beneficial and highlight the limitations of the system which are addressed by the involvement of an FA.

2. Data and methods

2.1. Study data and methodology

A systematic and thorough review of the cases, with request of the assistance of the Forensic Advisors, was performed and compared to cases without the involvement of the FAs' expertise. Homicide, robbery and burglary cases (between January 2014–June 2016) with and without the involvement of the FA were inventoried regarding a number of factors (see Table 1). These cases were chosen as they constitute the major part of the workload of the Forensic Advisors, in terms of primary type of offence and period of time.

For the inventory of the data, a Filemaker® database was created and the variables were manually encoded. These could then be extracted to Microsoft® Excel for pre-treatment. Statistical modelling, performed with the open software R®, was performed in order to determine the significant factors for the involvement of the Forensic Advisors.

2.2. Variables

The variables encoded for each case file were split into the categories based on Ribaux et al. [12] and updated by Bitzer et al. [13]: strategic, immediate, physical, criminal, and utility. The variables are outlined in Table 1.

Additional covariates, such as victim characteristics (number of victims, age and gender of victim(s)) for instance were included, where available, in order to determine if such factors influence the decision to request the involvement of the FAs. Indeed, these characteristics were shown to influence the clearance rate of homicide cases in Switzerland [14], it can thus be hypothesised that these factors also have an influence on the expertise made available in the investigation.

The dependent variable in this study was the involvement of FAs (Yes = 1, No = 0). The aim was to determine the factors leading to the request for Forensic Advisor in the case.

It should be noted that, when no information regarding one of the variables of interest could be found, it was set to 0 (not present). For instance, it was not always clear whether all the offenders were masked or had gloves on. In this case, the variables "Mask" and "Gloves" were set to 0.

2.3. Analytical strategy

In order to determine the factors involved in the decision to request an FA in the judicial case, classification modelling was performed. Algorithms for different recursive partitioning methods (decision tree- and rule-based models) were computed to select the important factors in our three models (homicide, robbery and burglary). The simpler models, CART and single decision tree C5.0 were compared to more complex models (boosted C5.0, bagged trees (treebag) and generalised linear models (glm)). The statistical procedure can be found in Kuhn and Johnson [15]. This type of classification modelling allows for the integration of different types of variables (binary, ordinal and continuous), which is necessary for our study.

Table 1
Description of indepentent variables.

Variable	Type	Description
Strategic		
Prosecutor or Investigating judge	Binary	Depending on the judicial phase, a King's prosecutor or an Investigating judge is responsible for the case (Prosecutor = 1)
Immediate		
Type of target	Nominal	Three categories: commercial (i.e. bar, post office), public (i.e. street, park), and private (i.e. apartment, house)
Surveillance camera	Binary	Predictor: surveillance camera images available, no information about the quality of these images
Witness report	Binary	Predictor: witness report available, no information about the quality of this report
Weapon	Binary	Predictor: a weapon (gun, knife, . . .) was used
Violence against victim	Binary	Predictor: the victim was physically attacked by the offender(s)
Number of offenders	Ordinal	Number of offenders described in the summary of the case
Mask	Binary	Offenders were described as being masked
Gloves	Binary	Offenders were described as wearing gloves
Physical		
Number of collected objects	Ordinal	Number of objects collected at the crime scene or at other locations
Number of collected traces at the crime scene	Ordinal	Number of traces collected at the crime scene or other locations, not included are finger marks and shoe marks
Number of analysed traces (before advice)	Ordinal	Cases with FOR involvement: Number of traces analysed before advice Cases without FOR involvement: Number of analysed traces
Criminal		
Known criminal link	Binary	Predictor: crime link is known, as registered in the database, the link is known before the analysis of the trace
Utility		
Suspect known	Binary	Suspect known in the case
Suspect known before advice	Binary	Cases with FOR involvement: Suspect known in the case before advice Cases without FOR involvement: Suspect known in the case
Suspect confessed	Binary	Suspect confessed

To compare the different algorithms, the dataset was partitioned in a training set and a test set (split ratio = 0.8), which were recursively resampled (n = 100). The highly correlated (threshold ≥ 0.75) as well as the variables with near zero variance were removed. The models were compared, by assessing the performance of the models through ROC (receiver operating characteristics) curves and the corresponding area under curve (AUC) values, sensitivity and specificity. The complete dataset was then used to construct the model with the chosen algorithm.

3. Results and discussion

3.1. Descriptive analysis of the dataset

Cases were chosen to obtain a similar proportion of cases with and without involvement of Forensic Advisors. In total, 97 cases with FA (53.0%) and 86 (47.0%) without FA could be accessed and studied. First, the cases with FA were studied, so that the same distribution per type of offence and district could be reached (see Table 2).

The first step of our study consisted of a descriptive statistical analysis of the raw data for each variable that considered the perspectives of the dependent variables: involvement of FAs.

Table 3 presents the breakdown of the number of cases with and without involvement of FAs.

3.2. Comparison and selection of classification modelling

In Table 3, the correlated or near zero variance variables are indicated for the data of the three different categories (robbery, burglary, and homicide). These variables were excluded from the modelling of the decision trees.

A comparison of the different classification models was performed. In order to assess the performance of these models, performance values (AUROC; Area under ROC measured through the combination of sensitivity and specificity) of the resampled training and the corresponding test sets were computed (see Fig. 1). The models have different degrees of complexity and interpretability. The best classification performance of our data, i.e. highest AUROC values, were obtained with the boosted C5.0 trees for the robbery and homicide data, and the bagged trees for the burglary data (see Table 4). As the aim of this study was to understand the decision process for the involvement of FAs for different types of cases, the simpler C5.0 decision tree model was privileged. Even though the performance of this model was generally lower than the more complex models, the simpler models are chosen as, rather than excellent predictive power of our models, understanding the interaction of the variables with our response variable was aimed for. Unlike complex models, convenient rules can be obtained from single classification trees like C5.0 which can easily be visualised.

3.3. Models per type of offence

As a similar proportion of cases with and without FA was selected from the start per type of offence; this variable was thus not included in the model. A model per type of offence was generated. The involvement of FAs in the case could indeed be influenced by the type of offence, and thus different models were obtained.

3.3.1. Robbery

Of the 18 independent variables that were considered in the modelling, 4 were used to construct the model (see Fig. 2). Thus, these 4 factors contributed to the decision to consult a FA in the robbery case, in the sense that the splits created by these factors led to the constitution of smaller, more homogeneous groups. The first variable was of strategic nature, and referred to the state of the case: was a prosecutor or an investigating judge in charge of the case. For the cases with FAs, the one requesting the FA was encoded. When an investigating judge was in charge, the FAs were not asked for their expertise. However, when a prosecutor was in charge, the involvement of a FA depended on the type of target. When the robbery was committed in a private setting (compared to commercial or public spaces), the FAs were almost always consulted. When a commercial or public space was targeted, it depended on the knowledge about whether the offender(s) were wearing gloves. If they were wearing gloves, the request for FA was done in 8 out of 10 cases. Otherwise, the involvement of FAs depended on the number of traces collected at the crime scene. The higher this number (or the number of collected objects as they are correlated), the more likely it was that the FA was consulted to give his or her expertise in the case.

For a robbery to case to be submitted to FAs, the case needed to be under the responsibility of the Public Prosecutor, committed in a private setting (e.g. house or apartment), gloves were worn by the offender(s) and more than 7 traces were collected at the crime scene. Indeed, this corresponded to the batch of “home invasion” cases that were submitted to the FAs in 2015, comprising roughly 40 robbery cases. As these were submitted in batch, it is not surprising that the utility dimension was not considered in the model and is thus not important for the decision to consult the FA. The FAs’ involvement was requested to determine any further analytical possibilities and to establish forensic links, if possible.

In another case handled by a FA, it was determined through a detailed case study, that roughly 60 judicial cases were accounted for as a single FA case. In this case, the Forensic Advisor’s task was to provide an overview of all results of forensic analyses performed in a multitude of cases. These cases had either been linked through modus operandi or through trace analysis. By providing the overview of traces, objects, analyses and results, possible further analyses could be devised.

3.3.2. Burglary

For burglary cases, 19 independent variables were tested and 5 were considered to influence the decision to consult a FA (see Fig. 3). The analysis of traces was determining for the involvement of FAs. When no traces were analysed, the FA was often consulted. The FA was thus requested before any analysis had been undertaken. When traces had been analysed, the knowledge about suspect identification was important, with more requests for

Table 2
Description of dataset in terms of type of offence, district and involvement of Forensic Advisors (FA).

N	Brussels		Antwerp		Liege		Total	
	With FA	Without FA	With FA	Without FA	With FA	Without FA	With FA	Without FA
Robbery	43	39	0	0	2	2	45 (51.7%)	41 (48.3%)
Burglary	9	6	10	10	1	2	20 (52.6%)	18 (47.4%)
Homicide	13	10	7	5	12	12	32 (53.3%)	27 (46.7%)
Total	65	55	17	15	15	16	97 (53.0%)	86 (47.0%)

Table 3
Descriptive statistics of the number of cases with and without involvement of FA (n = 185). The indices indicate the variables that were excluded from the modelling due to high correlation values or low variance (1 = robbery cases, 2 = burglary cases, 3 = homicide cases).

Variable	n	Robbery		n	Burglary		n	Homicide	
		With FA n (%)	Without FA n (%)		With FA n (%)	Without FA n (%)		With FA n (%)	Without FA n (%)
Strategic									
Prosecutor or Investigating judge									
Prosecutor	77	45 (63.1)	32 (36.9)	36	19 (52.8)	17 (47.2)	21	12 (57.1)	9 (42.9)
Investigating judge	9	0 (0.0)	9 (100.0)	2	1 (50.0)	1 (50.0)	38	20 (52.6)	18 (47.4)
Immediate									
Type of target									
Commercial	34	11 (32.3)	23 (67.7)	8	5 (62.5)	3 (37.5)	12	5 (41.7)	7 (58.3)
Private	37	30 (81.1)	7 (18.9)	22	13 (59.1)	9 (40.9)	23	15 (65.2)	8 (34.8)
Public	15	4 (26.7)	11 (73.3)	8	2 (25.0)	6 (75.0)	24	12 (50.0)	12 (50.0)
Surveillance camera									
Yes	16	9 (56.3)	7 (43.7)	4	2 (50.0)	2 (50.0)	6	3 (50.0)	3 (50.0)
No	70	36 (51.4)	34 (48.6)	34	18 (52.9)	16 (47.1)	53	29 (45.3)	24 (54.7)
Witness report									
Yes	81	41 (50 .6)	40 (49.4)	4	2 (50.0)	2 (50.0)	41	15 (36.6)	26 (63.4)
No	5	4 (80.0)	1 (20.0)	34	18 (52.9)	16 (47.1)	18	17 (94.4)	1 (5.6)
Weapon[2]									
Yes	56	28 (50.0)	28 (50.0)	0	–	–	42	19 (45.2)	23 (54.8)
No	30	17 (56.7)	13 (43.3)	38	20 (52.6)	18 (47.4)	17	13 (76.5)	4 (23.5)
Violence against victim[2]									
Yes	35	22 (62.9)	13 (37.1)	0	–	–	46	29 (63.0)	17 (37.0)
No	51	23 (45.1)	28 (54.9)	38	20 (52.6)	18 (47.4)	13	3 (23.1)	10 (76.9)
Number of offenders									
1	22	6 (27.3)	16 (72.7)	30	13 (43.3)	17 (56.7)	39	21 (53.8)	18 (46.2)
2	29	20 (70.0)	9 (30.0)	2	2 (100.0)	0 (0.0)	9	5 (55.6)	4 (44.4)
3	22	13 (59.1)	9 (40.1)	3	3 (100.0)	0 (0.0)	7	4 (57.1)	3 (42.9)
>3	13	6 (46.2)	7 (53.8)	3	3 (100.0)	0 (0.0)	4	2 (50.0)	2 (50.0)
Mask									
Yes	41	26 (63.4)	15 (36.6)	1	1 (100.0)	0 (0.0)	5	2 (40.0)	3 (60.0)
No	45	19 (42.2)	26 (57.8)	37	19 (51.4)	18 (48.6)	54	30 (55.6)	24 (44.4)
Gloves									
Yes	24	22 (91.7)	2 (8.3)	2	2 (100.0)	0 (0.0)	2	1 (100.0)	1 (100.0)
No	62	23 (37.1)	39 (62.9)	36	18 (50.0)	18 (50.0)	57	31 (54.4)	26 (45.6)
Physical									
Number of collected objects[1]									
0	36	17 (47.2)	19 (52.8)	10	4 (40.0)	6 (60.0)	0	–	–
1	20	10 (50.0)	10 (50.0)	14	7 (50.0)	7 (50.0)	2	1 (50.0)	1 (50.0)
2	2	1 (50.0)	1 (50.0)	3	2 (66.7)	1 (33.3)	2	0 (0.0)	2 (100.0)
3	5	3 (60.0)	2 (40.0)	4	3 (75.0)	1 (25.0)	1	0 (0.0)	1 (100.0)
4	4	2 (50.0)	2 (50.0)	1	0 (0.0)	1 (100.0)	3	1 (33.3)	2 (66.7)
5	5	3 (60.0)	2 (40.0)	0	–	–	3	1 (33.3)	2 (66.7)
6	1	1 (100.0)	0 (0.0)	1	1 (100.0)	0 (0.0)	2	2 (100.0)	0 (0.0)
7	0	–	–	0	–	–	2	1 (50.0)	1 (50.0)
8	1	0 (0.0)	1 (100.0)		–	–	3	2 (66.7)	1 (33.3)
9	1	0 (0.0)	1 (100.0)	1	1 (100.0)	0 (0.0)	1	0 (0.0)	1 (100.0)
10–19	8	6 (75.0)	2 (25.0)	3	1 (33.3)	2 (66.7)	14	7 (50.0)	7 (50.0)
20–29	2	1 (50.0)	1 (50.0)	0	–	–	9	6 (66.7)	3 (33.3)
30–39	0	–	–	1	1 (100.0)	0 (0.0)	7	3 (42.9)	4 (57.1)
40–49	1	1 (100.0)	0 (0.0)	0	–	–	3	1 (33.3)	2 (66.7)
50–99	0	–	–	0	–	–	3	3 (100.0)	0 (0.0)
>100	0	–	–	0	–	–	4	4 (100.0)	0 (0.0)
Number of collected traces on crime scene									
0	28	15 (53.6)	13 (46.7)	14	12 (85.7)	2 (14.3)	12	6 (50.0)	6 (50.0
1	12	3 (25.0)	9 (75.0)	10	0 (0.0)	10 (100.0)	3	0 (0.0)	3 (100.0)
2	5	1 (20.0)	4 (80.0)	4	2 (50.0)	2 (50.0)	0	–	–
3	8	3 (37.5)	5 (62.5)	1	0 (0.0)	1 (100.0)	0	–	–
4	9	7 (77.8)	2 (22.2)	1	0 (0.0)	1 (100.0)	0	–	–
5	2	1 (50.0)	1 (50.0)	2	2 (100.0)	0 (0.0)	4	0 (0.0)	4 (100.0)
6	2	1 (50.0)	1 (50.0)	1	1 (100.0)	0 (0.0)	1	0 (0.0)	1 (100.0)
7	2	0 (0.0)	2 (100.0)	1	1 (100.0)	0 (0.0)	1	1	1
8	4	2 (50.0)	2 (50.0)	0	–	–	0	–	–
9	4	2 (50.0)	2 (50.0)	1	1 (100.0)	0 (0.0)	1	0 (0.0)	1 (100.0)
10–19	5	5 (100.0)	0 (0.0)	2	0 (0.0)	2 (100.0)	13	9 (69.2)	4 (30.8)
20–29	4	4 (100.0)	0 (0.0)	1	1 (100.0)	0 (0.0)	5	2 (40.0)	3 60.0)
30–39	1	1 (100.0)	0 (0.0)	0	–	–	5	2 (40.0)	3 60.0)
40–49	0	–	–	0	–	–	3	2 (66.7)	1 (33.3)
50–99	0	–	–	0	–	–	5	5 (100.0)	0 (0.0)
>100	0	–	–	0	–	–	5	5 (100.0)	0 (0.0)
Number of traces analysed (before advice)									
0	47	36 (76.6)	11 (23.4)	14	13 (92.9)	1 (7.1)	19	13 (68.4)	6 (31.6)
1	14	2 (14.3)	12 (85.7)	8	4 (50.0)	4 (50.0)	2	0 (0.0)	2 (100.0)
2	6	2 (25.0)	4 (75.0)	6	1 (16.7)	5 (83.3)	2	1 (50.0)	1 (50.0)
3	9	0 (0.0)	9 (100.0)	5	1 (20.0)	4 (80.0)	6	1 (16.7)	5 (83.3)

Table 3 (*Continued*)

Variable	n	Robbery		n	Burglary		n	Homicide	
		With FA n (%)	Without FA n (%)		With FA n (%)	Without FA n (%)		With FA n (%)	Without FA n (%)
4	2	0 (0.0)	2 (100.0)	2	0 (0.0)	2 (100.0)	2	0 (0.0)	2 (100.0)
5	2	2 (100.0)	0 (0.0)	0	–	–	1	1 (50.0)	1 (50.0)
6	1	0 (0.0)	1 (100.0)	0	–	–	4	3 (75.0)	1 (25.0)
7	1	0 (0.0)	1 (100.0)	0	–	–	3	2 (66.7)	1 (33.3)
8	0	–	–	0	–	–	1	1 (100.0)	0 (0.0)
9	2	2 (100.0)	0 (0.0)	1	0 (0.0)	1 (100.0)	1	1 (100.0)	0 (0.0)
>10	2	1 (50.0)	1 (50.0)	2	1 (50.0)	1 (50.0)	17	9 (52.9)	8 (47.1)
Criminal									
Known criminal link									
Yes	14	8 (57.1)	6 (42.9)	8	4 (50.0)	4 (50.0)	10	6 (60.0)	4 (40.0)
No	72	37 (51.4)	35 (48.6)	30	16 (53.3)	14 (46.7)	49	26 (53.0)	23 (47.0)
Utility									
Suspect known[2,3]									
Yes	19	5 (26.3)	14 (73.7)	10	7 (70.0)	3 (30.0)	45	22 (48.9)	23 (51.1)
No	67	40 (59.7)	27 (40.3)	28	13 (46.4)	15 (53.6)	14	10 (71.4)	4 (28.6)
Suspect known before advice[1]									
Yes	15	1 (6.7)	14 (93.3)	10	7 (70.0)	3 (30.0)	41	18 (56.1)	23 (43.9)
No	71	44 (62.0)	27 (38.0)	28	13 (46.4)	15 (53.6)	18	14 (77.8)	4 (22.2)
Suspect confessed[1]									
Yes	0	–	–	1	0 (0.0)	1 (100.0)	12	5 (41.7)	7 (58.3)
No	86	45 (52.3)	41 (47.7)	37	20 (54.0)	17 (46.0)	47	27 (57.4)	20 (42.6)

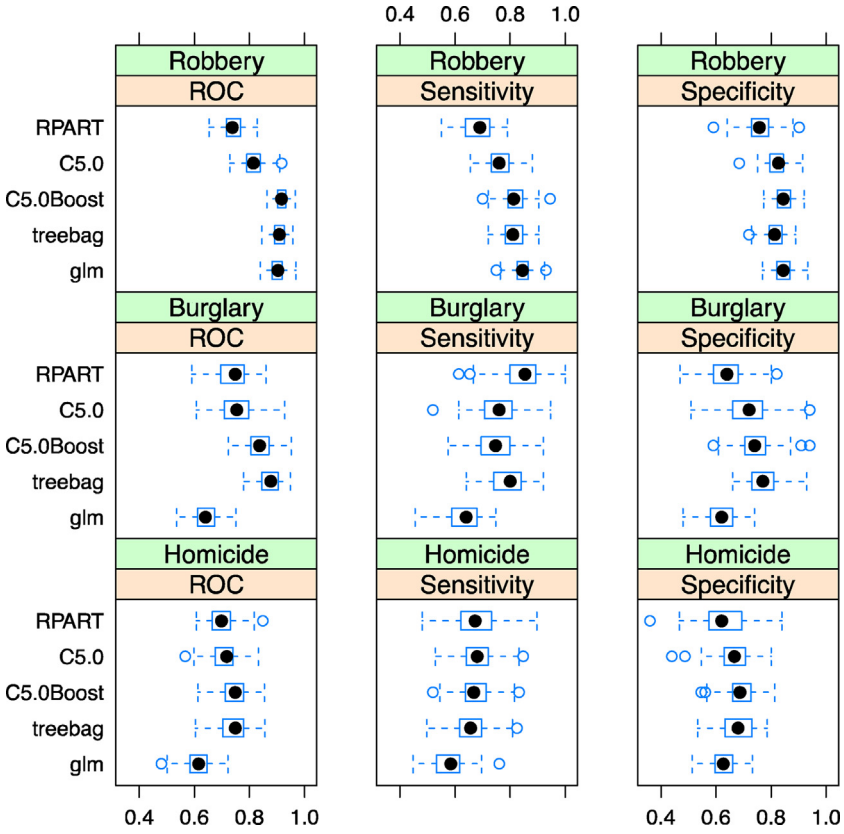

Fig. 1. Comparison of performance values (AUROC, sensitivity and specificity values) for all tested models using resampled training and test sets (n = 100) for robbery, burglary and homicide case data. For all models, the C5.0 decision tree models were chosen as compromise between good performance results and simplicity of interpretation.

an FA when the suspect had been known (62.5%) than when the suspect was not known (12.5%). When the suspect was known, the age of the victim was considered. In cases with the victim aged over 46, FAs were always consulted. When the victim was aged 46 or under, the FAs were never requested. Care must however be applied, as the number of cases falling into these categories was low (3 respectively 5).

When the suspect was not known, again the number of traces collected at the crime scene was considered (node 4). However, when no traces were collected and the burglary was committed in a commercial space (node 6), the FAs were requested. However, it is possible that in these cases, objects were collected at the crime scene. Thus, the FA could report on the analytical possibilities of these objects.

Table 4
Comparison of the values of AUROC, sensitivity and specificity of the best models (highest AUROC) and the model used for interpretation.

	Robbery		Burglary		Homicide	
	Best model	Model used	Best model	Model used	Best model	Model used
Model	Boosted C5.0	C5.0	Bagged tree	C5.0	Boosted C5.0	C5.0
Mean AUROC	0.918	0.815	0.875	0.765	0.747	0.712
Mean Sensitivity	0.815	0.762	0.790	0.765	0.674	0.687
Mean Specificity	0.848	0.821	0.777	0.735	0.690	0.663

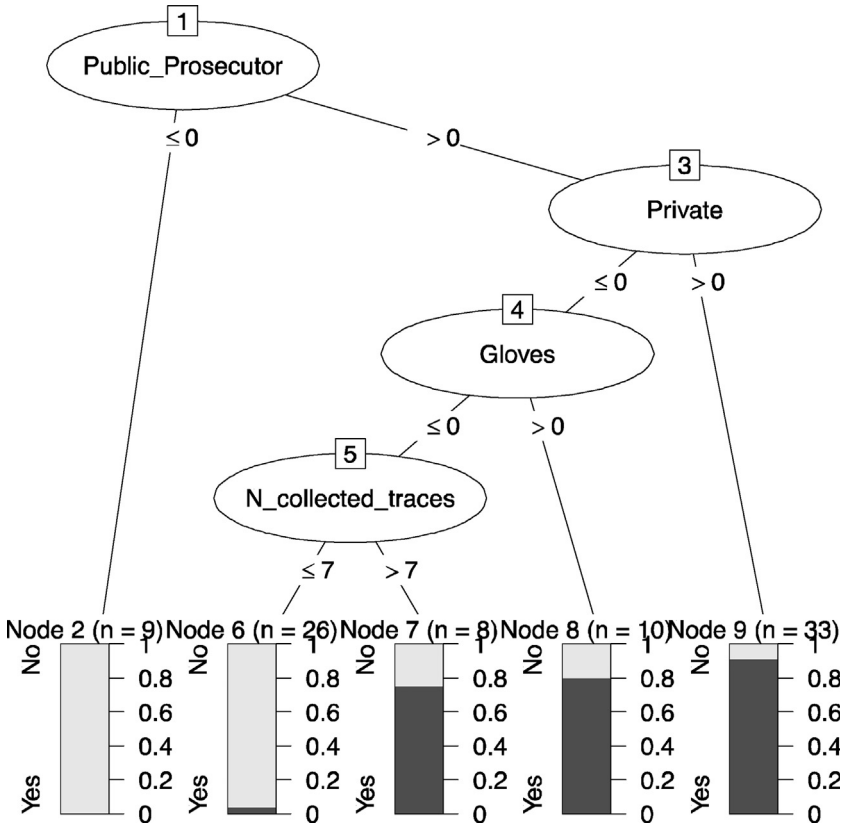

Fig. 2. C5.0 decision tree model of data from robbery cases.

3.3.3. Homicide

Only 4 of the 19 independent variables were used to construct the model of the decision to involve a FA in homicide cases (see Fig. 4). The first variable considered in the model for the homicide cases was the knowledge about witness reports. In cases without available witness reports, the FAs were often requested. When witness reports were available, the number of traces collected at the crime scene was important. When this number was above 40, the involvement of FAs was always requested. This showcases their role as triaging experts and case coordinators regarding the flow of traces and their analyses; first structuring all information in the case in order to gain an oversight. When the number of collected traces was below (or equal to) 40, the fact that a weapon was used is of importance. When a weapon was used (node 8), the FAs was requested in 20% of cases. However, when no weapon was used, the number of collected objects was considered in the model (node 5). Again, when this number was high (above 5, node 7), the expertise of the FAs was always requested. However, then 4 or less objects were collected, the FAs were consulted in roughly 20% of cases.

Again, knowledge about suspect identification through police enquiry did not influence the decision for the involvement of the FAs in the case. It appears to be the availability of witness reports that was of importance. This factor could be linked to the completion of the offence. Indeed, a witness report was available in the case of an attempted homicide, thus the victim could still inform on the events and the offender. Thus, in the case of an attempted homicide case, the FAs were less often consulted.

In cases where the suspect was already known, it was noted through the case study that the aim of the involvement of the FA was to verify the declarations of the suspect regarding the events (reconstruction of events) or to make a synthetic report of all analyses performed in the case.

4. Conclusion

The function of the Forensic Advisors at the National Institute for Criminalistics and Criminology in Brussels is relatively new and the roles they encompass have not been subject to scrutiny. The initial project defined the role of the FAs as advising body to the magistrate in complex homicide cases. These could thus be considered as conditions for the involvement of a Forensic Advisor. However, the workload has substantially diversified, including also simple and review cases. In addition, the types of offence mainly handled by the FAs still are homicide cases, with the addition of

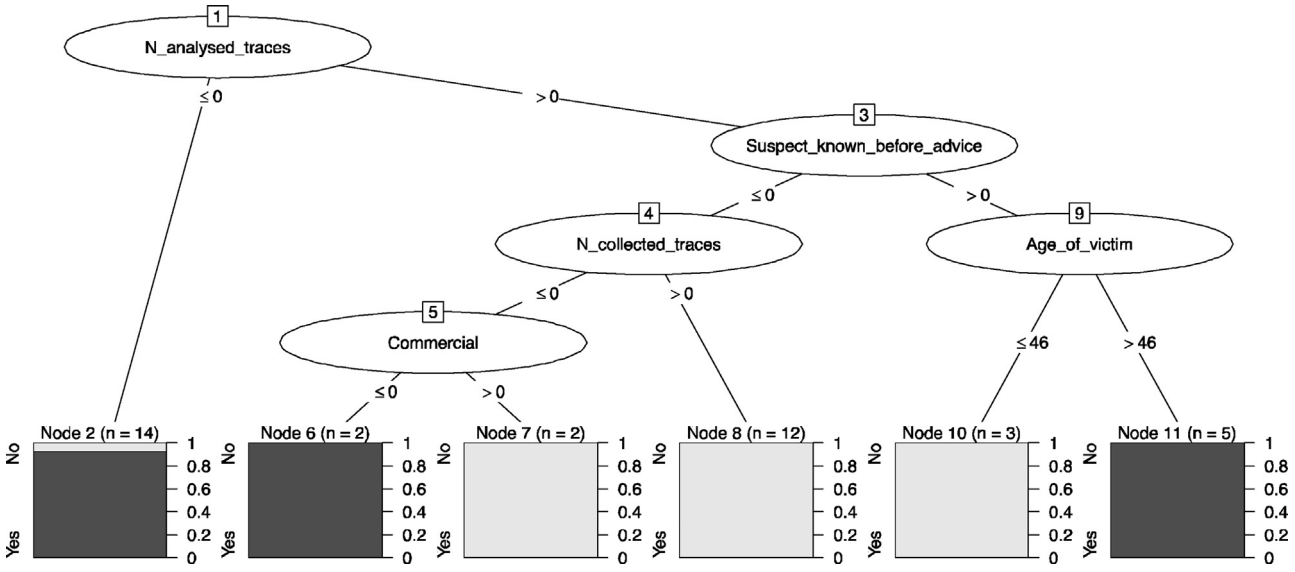

Fig. 3. C5.0 decision tree model of data from burglary cases.

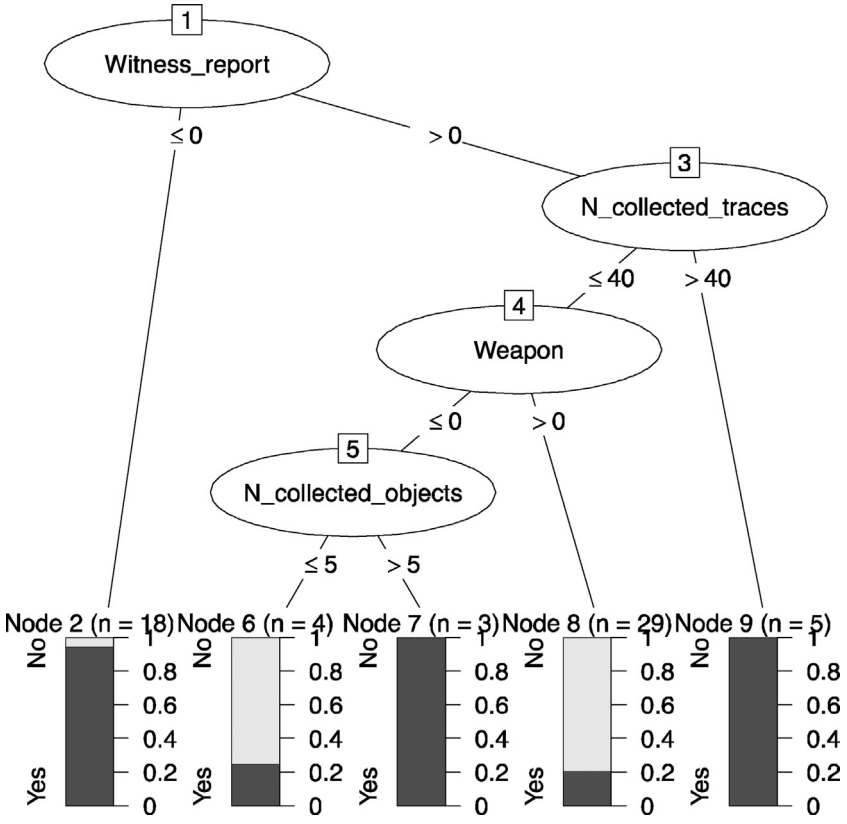

Fig. 4. C5.0 decision tree model of data from homicide cases.

robbery and burglary cases. Thus, it is important to determine the factors leading to the involvement of a Forensic Advisor in the criminal case. Other cases, with similar case characteristics could also be submitted to the Forensic Advisor and benefit from their expertise.

For all types of offence (robbery, burglary and homicide), the number of traces or objects collected at the crime scene is one of the main variables leading to the involvement of the FAs. The higher this number, the more often the FAs are requested to give advice in the case. In general, it can thus be inferred that FAs play a major role in triaging, thus choosing the relevant objects and traces for analysis. Although the factor "several types of expertise" was not considered in this study, one can infer that it is likely that, with the increase in number of traces, different types of traces needed to be handled. Thus, the coordination of different expertise (to be sampled simultaneously or not) might also play a role for the request of an FA. Through the case study, it could also be observed that complex murder cases with few collected objects and traces,

due to a late discovery for instance, are part of the cases for which an FA is requested.

Most of the robbery cases under scrutiny in this study were submitted to the Forensic Advisors at once. These cases, called "Home Invasion", were grouped together due to similar modus operandi: intrusion into private houses/apartments with elderly victims. Indeed, these case characteristics are reflected in the model constructed with the C5.0 algorithm. The Forensic Advisors were requested in order to determine potential analytical strategies. It was less about the triaging than about pointing out possible traces to be analysed. There was not a fixed set of traces ready for analysis (some collected objects could be the source of different types of traces), thus the FA outlined the possible collection and analysis procedures of traces and their expected utility in the case. Although, a link between the cases through modus operandi could be inferred, it could not be confirmed through trace analysis as no match was obtained.

The model built for the burglary cases is the only model that includes the utility dimension: knowledge about the suspect's identity. As the robbery cases were submitted to the FAs in batch, it is not surprising that this variable does not play a role for the involvement of the FAs. However, the non-consideration of this variable in homicide cases could be explained differently. Indeed, in homicide cases, the Forensic Advisor is contacted when the suspect remains unknown to help point out traces with high probability of yielding a useable profile and potentially a hit in the database (for biological traces) or when the suspect is known in order to corroborate or confirm the witness reports (e.g. reconstruction of the microsequence of events). The contribution they can provide to the case is thus different (see Ref. [16]).

Through the study of the factors determining the involvement of Forensic Advisors in judicial cases, the diversity of their roles is apparent. Their involvement in cases with a high number of traces or objects collected at the crime scene reveals their triaging capabilities, combined with the provision of an overview. A structural problem might be highlighted through the reasons for involvement of Forensic Advisors. Indeed, they are requested in cases involving a high number of objects or traces collected from crime scene. One part of their report is constituted of a summary of all available objects and traces, performed analyses and their respective outcomes. Thus, they provide an overview, which is not readily available from the original case file. Albeit, all objects inventoried at the Public Prosecutor's Office and all expert reports can be found within the case file, no system or document is at the magistrate's disposal creating a synthesis of this information. Forensic Advisors thus fill this gap in information gathering and synthesising.

This first part of the study focused on the factors leading to the involvement of a forensic advisor in the case. The number of cases per type of offence can be identified as a limitation, further studies should thus be carried out in order to strengthen the interpretation of the results. Ongoing studies are carried out to specify the influence of the Forensic Advisor on trace processing — the choice of traces to be analysed and their contribution to the case. In addition, a qualitative study will be carried out to highlight the perception of the different parties working with the forensic advisor regarding its involvement in the case.

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