



Contents lists available at ScienceDirect

Science and Justice

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

Emerging researcher article

Forensic expectations: Investigating a crime scene with prior information

Claire A.J. van den Eeden^{a,b,*}, Christianne J. de Poot^{a,b,c}, Peter J. van Koppen^b

^a Police Academy of the Netherlands, Research, Knowledge and Development, P.O. Box 348, 7301 BB Apeldoorn, The Netherlands

^b VU University Amsterdam, Criminology Department, De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands

^c Amsterdam University of Applied Sciences, Weesperzijde 190, 1097 DZ Amsterdam, The Netherlands

ARTICLE INFO

Article history:

Received 31 March 2016

Received in revised form 21 July 2016

Accepted 5 August 2016

Available online xxx

Keywords:

Expectancy effects

Contextual bias

Crime scene investigation

Decision making

Trace evidence

ABSTRACT

In a large body of research the influence of contextual information on decisions made in a broad range of disciplines has been studied. To date, the influence of these expectancy effects on the crime scene investigation has not been studied. In the present study we explored the effect of prior information given to crime scene investigators on their perception and interpretation of an ambiguous crime scene.

Participants ($N = 58$) were experienced crime scene investigators who were provided with a panoramic photograph of an ambiguous mock crime scene. The victim may have committed suicide or was murdered. Participants either received prior information indicating suicide, prior information indicating a violent death, or they received no prior information. Participants were asked about what they thought had happened at the scene of the crime, both at the initial assessment of the scene and at the end of the investigation when they were asked to describe the most likely scenario. They were also asked which traces they wanted to secure and why.

Results showed that participants interpreted the crime scene differently dependent on how it was presented to them. Both the initial assessment of the scene and the most likely scenario that was described after the investigation were influenced by the prior information the participants were provided with, even though roughly the same traces were secured by all, independent of the prior information.

Results demonstrate that prior information indeed influences the interpretation of the crime scene, but since the present study was exploratory further research is needed.

© 2016 The Chartered Society of Forensic Sciences. Published by Elsevier Ireland Ltd. All rights reserved.

1. Introduction

On 14th February 2004 the famous Italian cyclist Marco Pantani was found dead in a hotel in Rimini. The autopsy revealed heart failure caused by an overdose of cocaine. His death was a supposed suicide and the case was closed. Ten years later the Italian authorities reopened the investigation. It is now questioned whether the overdose was taken voluntarily. It is not unlikely that someone else was involved as there are still unanswered questions about a head injury and indications that his body was moved. There is doubt whether the crime scene was examined thoroughly enough [1]. If someone forced Pantani to take the lethal dose of cocaine the supposed suicide could become a case of murder.

In such cases the way in which the crime scene is handled may be influenced by the initial classification of the situation by the crime scene investigators. Typically, the scene of an alleged suicide is investigated differently and less thorough than the scene of an alleged murder. In the present study we empirically investigate whether that

initial classification of a crime scene as well as the further examination and interpretation of the scene of crime is influenced by prior expectations.

If the police are investigating a serious crime one of the first steps is often the examination of the crime scene. Since it is impossible to secure every single item or possible trace evidence at the scene, decisions have to be made during the examination about the relevance of the available physical evidence. There is only one opportunity to examine the scene of crime, so it is crucial that it is processed as precise and correct as possible.

One of the tasks of a crime scene investigator is to reconstruct what may have happened and, based on the reconstruction, to decide which traces are relevant and must be secured. The process of reconstructing the events before, during and after a crime is not a matter of ticking boxes on a checklist and following procedures, but involves active thinking. As all human thinking, this process can be prone to biases or errors in judgement.

In a large body of research the influence of expectancy effects or contextual information on decisions has been studied in a broad range of disciplines [2–5]. So far the influence of these expectancy effects on perception and decision-making at the scene of crime has been overlooked. In the present study we address that gap in the literature by exploring

* Corresponding author.

E-mail address: claire.van.den.eeden@politieacademie.nl (C.A.J. van den Eeden).

the influence of prior information on the perception and interpretation of an ambiguous crime scene.

1.1. Crime scene investigation

The process of reconstructing a crime usually begins with a walk-through of the scene. This preliminary round is done to give the investigator a rough idea of what happened, why it happened and how it happened. Inman and Rudin [6,7] describe that a preliminary hypothesis should be formulated at the start of the crime scene investigation. The hypothesis should be based on prior information and on the identification of potential evidence. The next step is the determination of the evidence: what evidence is present at the scene and which physical traces need to be secured. Finally, the evidence is secured. For example, fingerprints are 'lifted' and blood samples are taken for testing DNA.

Although there has been increased attention in papers on forensic science for the role of human cognition in the investigation of the crime scene [8–10] the main emphasis in most of the handbooks written about forensic science and crime scene processing is not on how the crime scene should be examined or how to find crime related traces. Instead, the focus of these handbooks is on preventing crime scene contamination and on the last step in the crime scene investigation: how to secure different types of physical evidence in an appropriate manner [11–15].

Saferstein [15] even writes that 'the know-how for conducting a proper crime-scene search for physical evidence is not beyond the grasp of any police department, regardless of its size. With proper training, police agencies can ensure competent performance at crime scenes. In many jurisdictions, police agencies have delegated this task to a specialized team of technicians. However, the techniques of crime-scene investigation are not difficult to master and certainly lie within the bounds of comprehension of the average police officer.'

The previous contention demonstrates the lack of emphasis on probably the most important first step: the initial assessment of the crime scene. All further decisions about the physical evidence are based on the initial perception and interpretation of the crime scene. It is important to think about where crime related traces can be found in each specific crime scene. For example, it may not be useful to first search for latent fingerprints on the front door when there are no signs of a forced entry. The contention, however, suggests that investigating a crime scene is a routine process that does not involve active thinking and that crime scene investigators do not require any special expertise.

An explanation for the fact that this first step is underexposed in handbooks on crime scene investigation could be that it is difficult to draft general guidelines on how to process a crime scene. The main argument is that every crime scene is unique. In a Home Office paper Tilley and Ford [16] wrote: 'In practice, however, almost all scene examination is less than fully comprehensive, since exhaustively combing every scene for any contact materials is clearly impractical. Prioritisation in scene examination seemed generally to be ad hoc. SOCOs [scenes of crime officers] value the professional autonomy to determine what should be examined and collected from the scene of an incident.'

This ad hoc decision making style may explain why instructions in police guidelines and handbooks on how to search a crime scene is limited to merely mentioning that the search must be conducted in an objective, systematic and methodological manner [13,17]. However, important questions such as why certain traces should be collected and how the crime scene is interpreted should not be overlooked, as the answers to these questions are the foundation of the further investigation.

Mistakes made during the investigation of the crime scene are impossible to rectify in hindsight. Once the crime scene is processed it will be released, meaning that the crime scene will no longer be protected [18]. Trace evidence can be damaged and items can be removed or added to the scene, making it impossible to restore it to

its original state at a later time. There is only one chance to properly process the scene, so it is crucial that it is done as precise and objective as possible.

1.2. Information

The visual inspection of the crime scene or 'walk-through' is not the only source of information that a crime scene investigator has at the start of the investigation. Before the investigator enters the scene he or she is briefed about the situation, typically by uniformed police officers. The investigator for instance receives information about how the body was found or who the victim is, to the extent that it is known at that time. That additional information can help the investigator with the reconstruction of the events before, during and after the crime. A hypothesis, which may help determining what kind of evidence to look for and where, can be formulated based on the information. Thus, crime scene investigators need information to search for and interpret evidence [10].

However, there is a chance that this case information unduly influences the investigator's thinking and interpretation and evidence that does not fit with the information is overlooked. Cooley and Turvey [19] note that information can consciously or unconsciously create expectations that can, as they put it, contaminate the forensic examiner's objectivity. The influence of these expectancy effects on perception and reasoning in the forensic domain is extensively explained by Risinger, Saks, Thompson, and Rosenthal [20], Saks, Risinger, Rosenthal, and Thompson [21], and more recently by Kassin, Dror, and Kukucka [22]. Although there has been increased attention for this 'forensic confirmation bias' [22], the influence of such expectancy effects on perception and decision making at a scene of crime has not been examined yet. Prior information about a case could influence expectations about what may be found at the crime scene. It is important to process a crime scene objectively, but how objective is the investigation when the examiner's objectivity is contaminated by expectations?

Expectancy effects occur most frequently when ambiguity is greatest [21,23]. Cooley and Turvey [19] point out the challenge for forensic examiners in a laboratory to interpret ambiguous stimuli (e.g., incomplete fingerprint), but that is also true for crime scene investigators. Objects found at the crime scene can be quite ambiguous in that scene. Objects may be interpretable in more than one way, depending on the explanation adopted of what has happened. The expectations about the case and the crime scene cannot only influence the interpretation of the crime scene as a whole, but also what is recognized as evidence and which pieces of evidence are secured. The complex nature of crime scene investigations raises the question if and to what extent, the investigators are vulnerable to expectancy effects.

To date expectancy effects or the influence of contextual information have been found in many different areas in the forensic (laboratory) domain, such as fingerprint comparisons [24], interpretation of DNA [25], polygraph examinations [26], interrogations [27], and recently also in verbal credibility assessment [28], forensic anthropology [29] and bite-mark comparisons [30]. Although these effects have been demonstrated in many studies, it has to be noted that some studies did not find an influence of contextual factors on forensic comparisons [31,32].

In the present study we address how experienced crime scene investigators are influenced by their expectations while processing an ambiguous crime scene. It is hypothesized that prior information received by crime scene investigators influences their expectations and thus influences the assessment of what happened at the scene of crime and the traces that are secured.

2. Method

2.1. Participants

Fifty-eight experienced Dutch crime scene investigators participated in the experiment. They were recruited among six different police

regions in The Netherlands. The age of the participants ranged from 27 to 63 years ($M = 44.8$, $SD = 8.9$). Participants had on average 8.5 years ($SD = 7.$) of experience with the investigation of crime scenes from serious criminal offenses. Fifteen (25.9%) of the participants were female.

2.2. Design

The experiment included three conditions in a between subjects design. With 'conditions' we refer to the versions of the experiment that were presented to the participants. The conditions were (1) prior information that indicated suicide, (2) prior information that indicated a violent death, and (3) prior information without any indication on the manner of death. All participants received a questionnaire on their background characteristics (for example: gender, age, level of education, years of experience as a crime scene investigator) prior to the study. Participants were assigned to the experimental conditions based on an equal distribution of their background characteristics. Therefore there were no significant differences in age ($F(1, 55) = 0.30$, $p = 0.74$), gender or years of experience ($F(1, 55) = 0.02$, $p = 0.99$) between the conditions. Dependent measures were the traces participants secured and their impressions of the scene.

2.3. Materials

For the present experiment a unique mock crime scene was constructed with help of forensic instructors of the Police Academy. In one of the crime houses that is routinely used for training purposes an anatomical female mannequin was hung in the stairwell. The crime scene was constructed to be ambiguous. The victim could have committed suicide or could have been murdered. There was evidence present for both scenarios, but in fact we constructed a crime scene of a murder that the perpetrator staged as a suicide. There were several crime related traces present in the mock crime scene that potentially could help the investigators with the interpretation of what had happened (see Appendix B).

Participants received different prior information about the case depending on the condition they were in. Participants in the suicide condition received information that a neighbour found the victim hanging and that the death was considered a supposed suicide. This was based on the situation encountered and the fact that the victim had a history of depression. A witness who had worked in the park in the street all day stated that he had not seen anything peculiar nor had he seen anyone leave the house.

Participants in the murder condition received information that a neighbour found the victim and that the death was considered a supposed murder. This was based on the situation encountered and the fact that there were previous reports of domestic violence at the address. A witness who had worked in the park in the street all day stated that he had seen a man leave the house at the end of the morning.

Participants in the control condition received information that a neighbour found the victim hanging and that there were no witnesses present near the premises.

The influence of prior information was measured at three different times in the investigation, namely at their initial assessment of the scene (first impression), during the investigation (traces they wanted to secure) and finally when they were finished with the investigation (most likely scenario).

After the crime scene was set up the ground floor of the house was recorded with a panoramic camera. The areas of the house that participants could investigate were the kitchen, the dining area, the living area, the staircase and the hallway (see Appendix A). In this particular case the upper floor of the house was not related to the crime and therefore not recorded. The 360-degree images were combined in a computer program, allowing participants to assess the crime scene in 360-degrees and walk through the ground floor in a game like manner. Detailed photographs of the crime scene were inserted into the

panoramic scene, making it possible to detect small forensic traces. Since it was not intended that participants would be able to find all the crime related evidence by just systematically clicking on all these so called 'hotspots', as many detailed photographs as possible were inserted into the panoramic scene. In this manner, all areas in the house could be assessed in more detail, with detailed photographs from both crime related and foil items, without giving away which areas and items were important. The 360-degree photograph thus contained 18 crime related and 30 foil detailed photographs or 'hotspots'.

2.4. Procedure

Participants were first asked to read the case information that differed according to the condition. After reading the information participants were provided with four normal photographs of the crime scene to get an overview of the situation. They were then asked to write down their first impression of what had happened ('what is your first impression of what has happened here?') and to rate how confident they were about that impression on a nine-point Likert scale ranging from 1 being 'very uncertain' to 9 being 'very certain'. The aim of presenting the participants with the photographs was to enable them to get a general view of the situation and to formulate a first impression, without already presenting them with detailed visual information about the crime scene.

Participants then received a general instruction on how to navigate through the panoramic photograph and were told to reconstruct what had happened and to secure all traces they considered to be crime related. After reading the instruction participants were asked to sit in front of the computer and assess the ambiguous mock crime scene in the 360-degree panoramic photograph. The time limit for their investigation was 30 min.

After investigating the crime scene participants received a questionnaire and were asked to write down which traces they wanted to secure and why. They could write down anything they considered relevant and there was no limit to the number of traces they could secure. Participants then had to prioritize the secured evidence, by selecting five traces that should be sent to the forensic laboratory for further analysis. Lastly, participants were again asked to write down what their impression of the crime scene was ('What could possibly have happened here and why?'). If multiple answers were given an additional question verified which of the options was most likely ('If you have indicated several possibilities which event is most likely?'). Participants were asked to rate how certain they were of the most likely event on a nine-point Likert scale (1 = very uncertain, 9 = very certain) and had to answer some additional questions about how motivated they were to make a proper reconstruction, whether they perceived time pressure and were confident in having found the important traces, all rated on a nine-point Likert scale.

After participants had finished the questionnaire a short interview was conducted. They were asked if there were certain aspects of the crime scene that drew their attention in particular, and to what extent they thought that prior information influenced their assessment of the crime scene. Finally, we posed a question about how they experienced investigating a crime scene in a virtual environment.

3. Results

3.1. First impression

In all three conditions the majority of the participants wrote down suicide as a scenario when we asked them to give their first impression after seeing the four photos (see Fig. 1). Only one participant, who was in the murder condition, wrote down murder as a scenario after the initial assessment of the scene. It can be seen in Fig. 1 that the

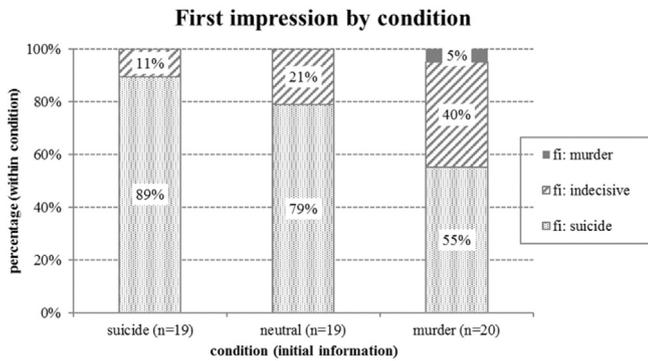


Fig. 1. First impression of the crime scene.

differences between the conditions were driven more by the number of “indecisive” than by the number of “murder” as a first impression.

In order to test whether the differences between the conditions were significant a Chi-Square test was performed. To enable us to get a full impression of the differences between the conditions the count, percentage and adjusted residuals of all cells were also displayed (see Table 1). The adjusted residuals indicate whether the counted numbers differ significantly from the expected numbers [33]. There was no overall significant association found between condition and first impression ($\chi^2(4) = 7.17, p = 0.09$), however in some cells, the counted and expected values did differ significantly. In the suicide condition, somewhat more participants than expected wrote down suicide as a first impression and somewhat fewer participants than expected wrote down indecisive as a first impression. In the murder condition, significantly fewer participants than expected wrote down suicide as a first impression and significantly more participants than expected wrote down indecisive as a first impression.

There was a significant effect of condition on confidence scores $F(2, 51) = 4.82, p < 0.05, \omega^2 = 0.12$. Post hoc comparisons using the Bonferroni correction indicated that participants in the suicide condition ($M = 6.2, SD = 1.8$) were significantly more confident about their first impression compared to participants in the murder condition ($M = 4.8, SD = 1.0$). The control condition ($M = 5.4, SD = 0.9$) did not differ significantly from both experimental groups.

3.2. Number of secured traces

A one-way ANOVA was performed on the number of traces the participants secured. Results showed a significant effect of condition on the number of secured traces $F(2, 55) = 3.18, p = 0.05, \omega^2 = 0.07$. Post hoc comparisons using the Bonferroni correction indicated that participants in the murder condition ($M = 17.8, SD = 6.6$) secured significantly more traces compared to participants in the suicide

condition ($M = 12.9, SD = 4.9$). The number of secured traces in the control condition ($M = 15.3, SD = 6.5$) did not differ significantly from both experimental groups.

3.3. Crime related traces

We had put several crime related traces in the mock crime scene that potentially could help the investigators with the interpretation of what had happened. Examples of these traces were blood on a door handle in the living room and some hairs around the victim's neck that were longer and had a different colour than the hair colour of the victim. Some exploratory analyses were conducted to examine whether participants secured other traces dependent on the condition they were in. These analyses showed no significant differences between the conditions as to which of the crime related traces were secured.

Exploratory analyses revealed no significant relation between the crime related traces that were secured and the initial most likely scenario. One exception were the foreign hairs on the victim's body. Participants who secured the hairs significantly more often had mentioned murder as the most likely scenario compared to participants who did not secure the hairs $t(56) = -2.89, p < 0.05, r = 0.36$.

3.4. Most likely scenario

After processing the crime scene, the participants again gave an overall assessment of what might have happened (see Fig. 2). It can be seen that participants in all conditions shift their opinion towards murder, compared to the initial assessment of the scene. Hence, processing the crime scene leads to more correct decisions, as in this case it was a murder scene, staged by the perpetrator as a suicide. Using Haberman's adjusted residuals procedure [33], we detect in cross Table 2 some small differences ($p < 0.10$) in two of the six cells, both in the “most likely: murder”-column, though an overall χ^2 test did not turn out to be significant ($\chi^2(4) = 4.79, p = 0.33$). All over we interpret these slightly contrary results as supporting the hypothesis of dependency between conditions and response, also because the effect size is rather large, the difference between the suicide and murder condition between the relative frequencies of “most likely: murder” is more than 34%. In the suicide condition fewer participants than expected wrote down “murder” as the most likely scenario, whereas in the murder condition more participants than expected wrote down “murder” as most likely scenario (see Table 2).

We also analysed whether there was a relationship between condition and participants' change in the view of the scene (e.g. did participants in the murder condition more often shift their opinion towards murder), but we found no differences between the conditions.

Participants were also asked how confident they were about their assessment of the most likely scenario after processing the crime

Table 1 Chi-square first impression.

Condition	fi: suicide	fi: indecisive	fi: murder
Suicide Count	17	2	0
% within condition	89.5%	10.5%	0.00%
Adjusted Residual	1.9*	-1.7*	-0.7
Control Count	15	4	0
% within condition	78.9%	21.2%	0.0%
Adjusted Residual	0.6	-0.4	-0.7
Murder Count	11	8	1
% within condition	55.0%	40.0%	5.0%
Adjusted Residual	-2.4**	2.0**	1.4

* $p < 0.10$.
** $p < 0.05$.

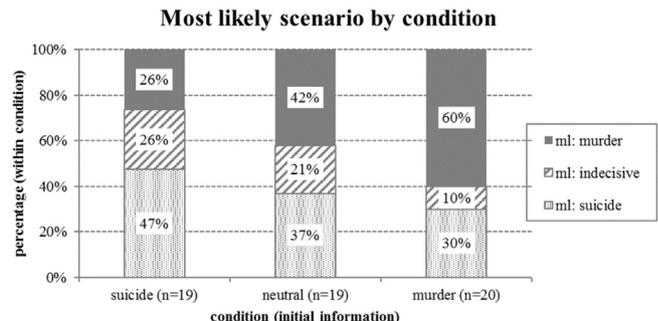


Fig. 2. Most likely scenario.

Table 2
Chi-square most likely scenario.

Condition	ml: suicide	ml: indecisive	ml: murder
Suicide count	9	5	5
% within condition	47.4%	26.3%	26.3%
Adjusted residual	1.0	1.0	−1.8*
Control count	7	4	8
% within condition	36.8%	21.2%	42.1%
Adjusted residual	−0.1	0.3	−0.1
Murder count	6	2	12
% within condition	30.0%	10.0%	60.0%
Adjusted residual	−0.9	−1.3	1.9*

* $p < 0.10$.

scene. A one-way ANOVA revealed no significant effect of condition on confidence scores $F(2, 49) = 0.28, p = 0.76$.¹

3.5. Other measures

To assess whether there were other factors that could explain the differences in the interpretation of the crime scene some additional one-way ANOVAs were performed. Results indicated no significant effect of condition on motivation to make a proper reconstruction of the event $F(2, 55) = 0.09, p = 0.92$, perceived time pressure $F(2, 55) = 0.03, p = 0.98$ or confidence in seeing the important traces $F(2, 55) = 0.09, p = 0.98$.

4. Discussion

The aim of the present study was to investigate whether prior information would influence the interpretation and decision-making at a crime scene. It was expected that participants would secure different traces and have a different view of what had happened at the crime scene, depending on the prior information they had received. The analyses that were conducted to test these expectations showed that participants indeed interpreted the crime scene differently, dependent on the condition they were in. This effect was especially present in the murder and suicide conditions.

Firstly, the analyses showed that in the suicide condition more participants than expected wrote down suicide as a first impression and fewer participants than expected wrote down indecisive as a first impression. In the murder condition the opposite happened, fewer participants than expected wrote down suicide as a first impression and more participants than expected wrote down indecisive as a first impression. Furthermore, results revealed that the participants in the suicide condition had significantly more confidence in their first impression of the crime scene compared to participants in the murder condition. These findings could be explained by the fact that, at first glance, the crime scene looks very clean and neat. There are no obvious signs of a struggle or a violent offense. This is in accordance with the fact that the crime scene was staged as a suicide by the perpetrator. For participants in the suicide and control condition, this image was not contradicted by the prior information they had received, which might have made them more willing to follow the suggestion of a suicide. Whereas participants in the murder condition were a bit more hesitant to write down suicide as a first impression, as this was contradicted by the prior information that was presented to them.

Secondly, results revealed that in the suicide condition fewer participants than expected wrote down “murder” as the most likely scenario, whereas in the murder condition again the opposite happened with more participants than expected who wrote down “murder” as most

likely scenario. This is in line with findings by for example, Dror et al. [24] who demonstrated that contextual information influenced the decision making of fingerprint experts. When the experts were presented with a different context the majority of the experts made different decisions about whether the same fingerprints were a match or a non-match.

To summarize the findings concerning the interpretation of the crime scene: both the initial assessment of the scene and the most likely scenario that was written down after the investigation was finished seemed to be influenced by the prior information the participants were provided with, even though roughly the same traces were secured. There was no evidence found that other factors such as motivation, perceived time pressure or confidence in seeing the important traces explained the different interpretations of the scene between the conditions. It should, however, be noted that in the present study a substantial number of participants explained that the most likely scenario was not a conclusion but an evaluation of an uncertain situation. Most participants wrote down two possible scenarios (murder or suicide) and the majority of the participants indicated that they would have to wait for the lab results of the traces before they could come to a definite conclusion.

The second expectation of the present study concerned the traces participants would secure. It was expected that participants in the suicide condition would focus more on for example the suicide note and the medication and participants in the murder condition would focus more on the rope, the knot and evidence on the victim's body. Contrary to expectations, no evidence was found to support that expectation. There were no significant differences between the conditions as to which crime related traces the participants secured. A possible explanation for this null finding is that, in this case, traces were not distinctive enough. To differentiate between the scenarios murder and suicide the same traces had to be secured and tested. Furthermore, securing traces is done routinely to a great extent. Crime scene investigators have more or less fixed locations where they look for evidence in certain types of cases. In this case, most of the traces could be found in logical places for a suspicious death, providing an additional explanation for the null finding. The few traces that could be found in atypical places were, consequently, secured less often by all participants. So, some traces were secured by almost all participants, whereas other traces were secured by only a small minority of participants, making it difficult to analyse the influence of secured traces on the most likely scenario.

Although it was not a major factor under study, a significant effect of condition on the number of secured traces was found. On average, participants secured most traces in the murder condition and least in the suicide condition. It might be the case that participants in the murder condition approached the crime scene as a more serious case in which they did not want to risk not securing possibly important traces. Also, crime scene investigators, like all employees in the police force, have to work cost effective. Securing and sending in traces for further analyses costs money. It is more common to make these costs for solving a presumable murder case than to exclude the possibility that a likely suicide might actually be a murder.

4.1. Limitations

A potential limitation of the current study is that it relied on a mock crime scene that was presented in a virtual environment. Several participants indicated that they missed the ‘feel’ of an actual crime scene. It is different when you are not able to walk around in person and perceive, smell and hear things as you would in a real (world) scene. Furthermore, in cases like these, the victim's body is an important source of information for the crime scene investigators. They can, for instance, assess whether there are defensive wounds and how the livor mortis is developed, to see if it fits with the rest of the evidence in the crime scene. In this study, an anatomical mannequin was used, so it was not possible for the crime scene investigators to include this information in their assessment of the scene. Also, the gender of the mannequin

¹ A new variable was created to explore the relationship between condition, most likely scenario and confidence in more depth adopting the method of Ask and Granhag [2]. Results showed again no significant differences between the conditions $F(2, 44) = 0.82, p = 0.45$.

was female. In the present study, gender of the victim was not a factor under study and therefore not included as a condition, but this may have been a factor in decision-making.

A further limitation of the present study includes the small sample size of 58 crime scene investigators. To test for statistical significance a larger sample size is preferable. However, forensics is a specialized department within the police force and there are only a couple of hundred crime scene investigators working in The Netherlands. Also, only one type of case, consisting of one crime scene, was used to test the possible influence of prior information. Findings from the present study can therefore not be generalized to all crime scenes and all criminal cases.

A third potential limitation concerns the large standard deviations for the number of secured traces. Although this variance also occurred in the control condition and we therefore cannot say that it is a result of the prior information, we did not expect such large differences in the number and nature of the secured traces.

The differences that we found in this study were only present between the two experimental groups who received contextual prior information. There were no differences between one of the experimental conditions and the control condition. However, one can argue whether this is a problem. It hardly ever happens that a crime scene investigator goes to a scene without any prior information. Other police officers, who are usually the first ones present at the scene share their findings before the crime scene investigators start the investigation.

As the present study was an exploratory study, it is difficult to compare the results with other findings. Therefore, more empirical work needs to be done on this research topic to gain more insight in the influence of prior information and the implications findings might have on the work of crime scene investigators. Additional studies could for instance use a different crime scene, a different case, different gender or age of the victim, a physical mock crime scene instead of a virtual scene or have more distinguishing traces in the scene.

5. Conclusion

Although a substantial body of literature is dedicated to the influence of expectancy effects in forensic contexts the present study is the first in which the influence of these effects on decision making at the scene of crime is explored. There are some limitations that have to be taken into account, but findings do indicate that prior information appears to have an influence on the initial assessment of the scene, then no influence is found on the traces that were secured and the influence is again present for the most likely scenario that was formulated after finishing the investigation. Investigating a crime scene involves complex information processing with different types of information such as visual, oral and written that all have to be weighed and considered carefully. Also, securing traces is partly routine work. Despite all these possibly confounding factors results of the present study demonstrate that the influence of prior information reaches as far as the end of the crime scene investigation, namely the most likely scenario that is formulated.

In the present study, we found substantial evidence for the influence of cognitive biases on the interpretation of the crime scene. At the same time, detectives' routines and policies set in place seem to mitigate the influence of cognitive biases on their behaviour at the crime scene (i.e. which traces they secured).

Besides displaying important findings the present study also raises some important questions, as little is still known about decision making at the scene of crime. It was mentioned above that crime scene investigators have great professional autonomy and there are little guidelines on how to search for evidence and interpret a crime scene.

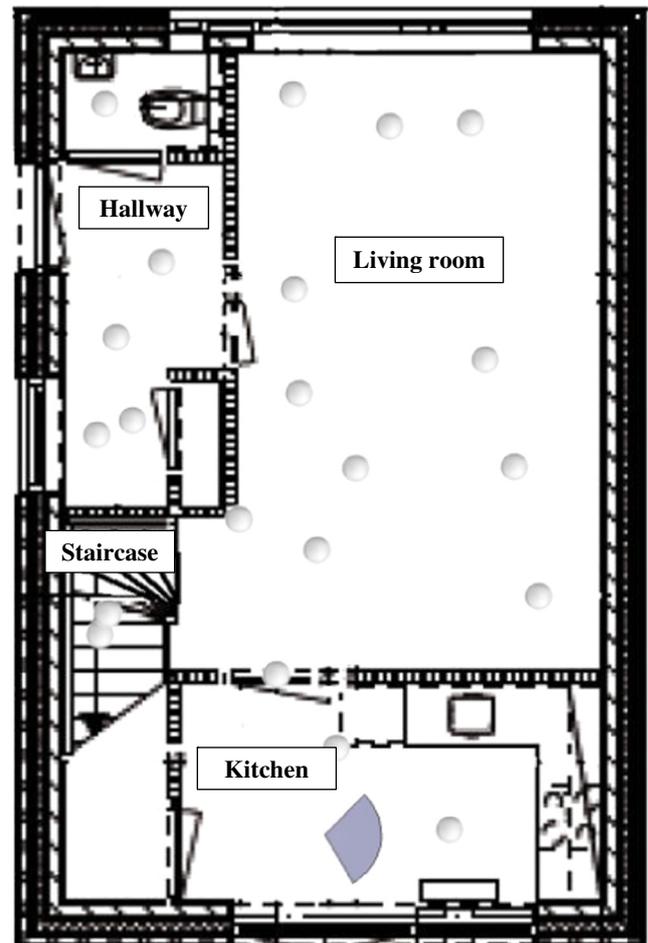
The present study aims to be the starting point of gaining more knowledge about the influence of prior information and expectations on perception and decision making at the scene of crime, as it is essential that these mechanisms are better understood in order to prevent biased decisions as much as possible in the future.

Acknowledgements

The authors would like to thank Alexander de Bruijn and Ellen Kooij for their help with the panoramic photograph. The instructors at the Police Academy for their help with constructing the crime scene, with special thanks to Wim Gijgink, Paul Langenakker, Peter van Rijn and Dick Aamtmeijer. And of course the crime scene investigators for participating in this study.

Appendix A

Map of the ground floor.



Appendix B

Crime related evidence in the mock crime scene.

- Rope
- Knot
- Victim
- Hairs on victim
- Robe
- Blood on chair
- Blood on door handle
- Gravel from flower pot
- Fallen candle holder
- Suicide note
- Medication
- Pen
- Glass

Diary
Coffee cups
Cigarettes
Shopping list

References

- [1] Nieuw Onderzoek Naar Dood Pantani [New Investigation into Death Pantani], in, 2014.
- [2] K. Ask, P.A. Granhag, Motivational bias in criminal investigators' judgments of witness reliability, *J. Appl. Soc. Psychol.* 37 (2007) 561–591.
- [3] B.H. Bornstein, A.C. Emler, Rationality in medical decision making: A review of the literature on doctors' decision-making biases, *J. Eval. Clin. Pract.* 7 (2001) 97–107.
- [4] S.D. Charman, A.H. Gregory, M. Carlucci, Exploring the diagnostic utility of facial composites: beliefs of guilt can bias perceived similarity between composite and suspect, *J. Exp. Psychol.-Appl.* 15 (2009) 76–90.
- [5] P.A.F. Fraser-Mackenzie, I.E. Dror, K. Wertheim, Cognitive and contextual influences in determination of latent fingerprint suitability for identification judgments, *Sci. Justice* 53 (2013) 144–153.
- [6] K. Inman, N. Rudin, Principles and Practice of Criminalistics: The Profession of Forensic Science, CRC Press, Boca Raton, FL, 2000.
- [7] K. Inman, N. Rudin, The origin of evidence, *Forensic Sci.Int.* 126 (2002) 11–16.
- [8] C. Baber, P. Smith, J. Cross, J.E. Hunter, R. McMaster, Crime scene investigation as distributed cognition, *Pragmat. Cogn.* 14 (2006) 357–385.
- [9] R.J. Garrett, A primer on the tools of crime scene analysis, *J. Forensic Identification* 53 (2003) 656–665.
- [10] I.E. Dror, Cognitive neuroscience in forensic science: understanding and utilizing the human element, *Philos. Trans. R. Soc.* 370 (2015) 1–8.
- [11] J.T. Fish, L.S. Miller, M.C. Braswell, *Crime Scene Investigation*, 2nd ed Elsevier, Burlington, MA, 2011.
- [12] B.A. Fisher, D.R. Fisher, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton, FL, 2012.
- [13] R.M. Gardner, *Practical Crime Scene Processing and Investigation*, CRC Press, Boca Raton, FL, 2012.
- [14] R.M. Gardner, T. Bevel, *Practical Crime Scene Analysis and Reconstruction*, CRC Press, Boca Raton, 2009.
- [15] R. Saferstein, *Criminalistics: An Introduction to Forensic Science*, 9th ed Pearson Upper Saddle River, NJ, 2007.
- [16] N. Tilley, A. Ford, *Forensic Science and Crime Investigation*, Home Office (Police Research Group: Crime Detection and Prevention Series), London, 1996.
- [17] D. Wyatt, Practising crime scene investigation: trace and contamination in routine work, *Polic. Soc.* 24 (2014) 443–458.
- [18] A. Van Amelsvoort, H. Groenendal, Handleiding optreden plaats delict [Crime scene investigation manual], Reed Amsterdam, 2013.
- [19] C.M. Cooley, B.E. Turvey, Observer Effects and Examiner Bias: Psychological Influences on the Forensic Examiner, in: *Crime Reconstruction*, Elsevier, Boston, 2007.
- [20] D.M. Risinger, M.J. Saks, W.C. Thompson, R. Rosenthal, The Daubert/Kumho implications of observer effects in forensic science: hidden problems of expectation and suggestion, *Calif. Law Rev.* 90 (2002) 1–56.
- [21] M.J. Saks, D.M. Risinger, R. Rosenthal, W.C. Thompson, Context effects in forensic science: a review and application of the science of science to crime laboratory practice in the United States, *Sci. Justice* 43 (2003) 77–90.
- [22] S.M. Kassin, I.E. Dror, J. Kukucka, The forensic confirmation bias: problems, perspectives, and proposed solutions, *J. Appl. Res. Memory and Cognition* 2 (2013) 42–52.
- [23] I.E. Dror, A.E. Peron, S.L. Hind, D. Charlton, When emotions get the better of us: the effect of contextual top-down processing on matching fingerprints, *Appl. Cogn. Psychol.* 19 (2005) 799–809.
- [24] I.E. Dror, D. Charlton, A.E. Peron, Contextual information renders experts vulnerable to making erroneous identifications, *Forensic Sci.Int.* 156 (2006) 74–78.
- [25] I.E. Dror, G. Hampikian, Subjectivity and bias in forensic DNA mixture interpretation, *Sci. Justice* 51 (2011) 204–208.
- [26] E. Elaad, A. Ginton, G. Benschakhar, The effects of prior expectations and outcome knowledge on polygraph examiners decisions, *J. Behav. Decis. Mak.* 7 (1994) 279–292.
- [27] S.M. Kassin, C.C. Goldstein, K. Savitsky, Behavioral confirmation in the interrogation room: on the dangers of presuming guilt, *Law Hum. Behav.* 27 (2003) 187–203.
- [28] G. Bogaard, E.H. Meijer, A. Vrij, N.J. Broers, H. Merckelbach, Contextual bias in verbal credibility assessment: criteria-based content analysis, reality monitoring and scientific content analysis, *Appl. Cogn. Psychol.* 28 (2014) 79–90.
- [29] S. Nakhaeizadeh, I.E. Dror, R.M. Morgan, Cognitive bias in forensic anthropology: visual assessment of skeletal remains is susceptible to confirmation bias, *Sci. Justice* 54 (2014) 208–214.
- [30] N.K.P. Osborne, S. Woods, J. Kieser, R. Zajac, Does contextual information bias bitemark comparisons? *Sci. Justice* 54 (2014) 267–273.
- [31] J.H. Kerstholt, A. Eikelboom, T. Dijkman, R. Stoel, R. Hermesen, B. van Leuven, Does suggestive information cause a confirmation bias in bullet comparisons? *Forensic Sci. Int.* 198 (2010) 138–142.
- [32] J.H. Kerstholt, R. Paashuis, M. Sjerps, Shoe print examinations: effects of expectation, complexity and experience, *Forensic Sci. Int.* 165 (2007) 30–34.
- [33] S.J. Haberman, Analysis of residuals in cross-classified tables, *Biometrics* 29 (1973) 205–220.