The Influence of Rapid Identification Technologies on CSI Behaviour

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CHAPTER 2

THE INFLUENCE OF NEW TECHNOLOGIES ON THE VISUAL ATTENTION OF CRIME SCENE INVESTIGATORS PERFORMING A CRIME SCENE INVESTIGATION

ABSTRACT[1]

Currently, a series of promising new tools are under development that will enable Crime Scene Investigators (CSIs) to analyse traces in situ during the crime scene investigation or enable them to detect blood and provide information on the age of blood. An experiment is conducted with thirty CSIs investigating a violent robbery at a mock crime scene to study the influence of such technologies on the perception and interpretation of traces during the first phase of the investigation. Results show that in their search for traces, CSIs are not directed by the availability of technologies, which is a reassuring finding. Qualitative findings suggest that CSIs are generally more focused on analysing perpetrator traces than on reconstructing the event. A focus on perpetrator traces might become a risk when other crime-related traces are overlooked, and when analysed traces are in fact not crime-related and in consequence lead to the identification of innocent suspects.

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2.1 Introduction

In recent years, there has been a considerable increase in the number and kinds of technologies that can be used by Crime Scene Investigators (CSIs, which are known as Scene of Crime Officers (SOCOs) in Europe and the UK) to perform their work. Advanced technologies may facilitate the detection of traces (Barash, Reshef, & Brauner, 2010; Makrushin, Kiertscher, Hildebrandt, Dittmann, & Vielhauer, 2013) or otherwise expedite the investigation (Lounsbury, Bienvenue, & Landers, 2010). A group of new tools with the potential to speed up an investigation are the so-called rapid identification techniques, which will enable CSIs to analyse traces in situ during the crime scene investigation. Identification techniques, such as a rapid DNA identification technique that allows CSIs to analyse DNA traces in ninety minutes (Lounsbury et al., 2010; Mapes, Kloosterman, & De Poot, 2015) or a fingerprint technique that makes it possible to analyse fingerprints in thirty minutes, may soon become reality (Kurpershoek, 2009). Instead of waiting for days, weeks or even months, results can be made available while the crime scene investigation is still underway. Another promising development is a spectral camera that can be used to detect blood on visually problematic places such as dark surfaces. Such a camera can moreover provide an indication of the age of a bloodstain (Edelman, Van Leeuwen, & Aalders, 2013). These developments may change the investigation, as trace analysis decisions can already be made during the crime scene investigation itself. Also, the focus of the CSI may change, bearing in mind that attention can change depending on the goal of the observer, which in this case could be to find traces suitable for the technique (Chun & Wolfe, 2008). This paper investigates the influence of the availability of these techniques on the perception and interpretation of traces in the first phase of the crime scene investigation. As the term 'trace' can have different meanings, for this paper the terminology is derived from the term used by (Wyatt, 2014) and refers to all types of trace and items at the crime scene possibly related with the crime under investigation, and can be collected and removed from the crime scene for scientific analysis and/or potential use as evidence.

2.1.1 First phase of the investigation

The new technologies allow CSIs to analyse traces already at the crime scene. However, before traces can be collected and analysed in order to reconstruct what happened, trace evidence should, first, be observed at the crime scene and, second, it should be recognised as evidence. In the Netherlands, crime scene investigation is divided into four phases: an orientation phase (1), a phase in which a plan of approach is created (2), forensic examination (3), and a final round after which preliminary results are formulated

(4); (Van Amelsvoort & Groenendal, 2013; Van Amelsvoort, Groenendal, & Van Manen, 2004). Dutch rules are in line with guidelines in international handbooks that instruct CSIs to use phases or steps to structure the crime scene investigation, so as to minimise the chance of missing important traces. This paper focuses on the orientation phase, given its significant role within the investigation. Recognition of evidence starts during this first phase (Inman & Rudin, 2001). Several handbooks describe the first phase as an exploratory round in which CSIs assess the situation, observe the scene, discover clues and possible evidence, and record information. The scene should be screened in order to decide where the most relevant traces are likely to be found and to determine which hypotheses and scenarios should be considered (Gardner, 2012; Van Amelsvoort & Groenendal, 2013; Weston & Lushbaugh, 2009). Inman & Rudin (2001) point out that a preliminary hypothesis should be based on the recognition of aspects of the crime under investigation and the initially presented information. CSIs need to decide on a proper course of action and strategy, based on the preliminary hypothesis formulated and the information gathered in this initial round (Inman & Rudin, 2001; Van Amelsvoort & Groenendal, 2013). Moreover, it is well known that once an idea has been formed, people tend to cling to it and therefore risk overlooking important but unexpected information (Nickerson, 1998). Hence, the exploratory round lays the foundation for the course of the entire process.

2.1.2 Visual attention and the recognition of evidence

During the investigation, a CSI has to search for crime-related information and ignore nonrelated information. People in general are active information seekers and processors. According to research in the field of visual attention, attention can be either goal-driven or stimulus-driven. Attention is held to be goal-driven when it is controlled by the observer's strategies and intentions (Yantis, 1998). Hence, depending on their goals and expectations, people interpret the stimuli present in the environment in a certain way, and guided by their goals and by their interpretation of the situation, their attention is focused on certain aspects of the situation, while other aspects are ignored (Chun & Wolfe, 2008; Yantis, 1998). Attention is held to be stimulus-driven when it is controlled by prominent characteristics of the environment that are not essentially relevant to the observer's intentions and goals. Instead of operating as independent mechanisms, both mechanisms complement one another as stressed by Yantis (1998).

Visual attention (Chun & Wolfe, 2008) is also operative when a person observes a crime scene. Unexpected stimuli present at the scene will shape ideas about what might have happened (bottom-up processing). At the same time, the task or goal and the expectations of the officer will determine to a large extent, unconsciously, the area of

attention within the abundance of stimuli present at a crime scene (top-down processing). To find out what happened, CSIs have to create order, and must focus their attention on what they think are crime-related traces. Many different cues can serve as evidence, for example DNA traces, shoeprints or fingerprints (Fisher & Fisher, 2012; Gardner, 2012; Inman & Rudin, 2001). By focusing their attention, CSIs try to select relevant information and to ignore irrelevant or even interfering information (Chun & Wolfe, 2008). Deciding which information can be crime-related and ought to be taken into consideration when reconstructing a crime is an important task for crime scene officers, and how they focus their attention can influence this decision-making process. The difficulty of the search process relates to the fact that many of the traces present at a crime scene will not so much link the offender to the crime scene, but provide a link between the victim and the scene or relate to other people legitimately connected to the crime scene. Some types of evidence immediately relate to the criminal event, but for other types of evidence, the connection with the crime may not be that obvious.

A consequence of the availability of new techniques might be a change in the visual attention of the CSI. Instead of looking for all types of crime-related traces, the focus of the CSI using a rapid identification technique might shift to those specific kinds of traces that are likely to be detected by these techniques, such as DNA, fingerprints or blood traces. When the attention of a CSI is not on finding all kinds of crime-related traces but more on finding, for example, DNA traces, other important traces might be overlooked or irrelevant DNA traces might dominate the investigation.

The visual attention mechanism of a CSI starts operating during the orientation phase: a lot of information is present at the scene and the investigator has to decide which information is relevant and which is not. Focusing might therefore already start during this exploratory round. If the focus of a CSI indeed changes from searching for traces that have a direct link with the crime to specific traces suitable for the technique, then this can clearly influence the entire crime scene investigation.

2.1.3 Finding traces

To understand the influence of new technologies, it is important to gain insight into the normal procedures at the crime scene. Apparently, not much research is conducted on the actual work of CSIs at the crime scene. In the present study, the focus is on the initial finding of traces at the crime scene, while most current forensic scientific research concentrates on the processes after the CSI has found trace evidence. Research that does concentrate on the crime scene mainly focuses on the development of technologies to locate and secure traces that are left behind at a crime scene (Barash et al., 2010;

Makrushin et al., 2013; Van Amelsvoort & Groenendal, 2013; Van Oorschot, Ballantyne, & Mitchell, 2010).

In this way, an important topic within forensic science is at risk of being neglected. Before a trace can be collected, analysed and interpreted, it has to be perceived at the crime scene and it has to be recognised as evidence. Various handbooks have proposed protocols for crime scene processing (Fisher & Fisher, 2012; Gardner, 2012; Inman & Rudin, 2001), although the content of these protocols mainly refer to how to *secure* traces rather than how to *find* traces. Published guidelines do also specify structured search strategies, such as screening the crime scene by walking in circles or in lines (Gardner, 2012; Van Amelsvoort & Groenendal, 2013; Weston & Lushbaugh, 2009). Structuring an investigation is likely to contribute to the registration of more information, but how do CSIs decide whether information and traces are relevant or not? Handbooks are silent on this topic, as Lee & Pagliaro (2013) already observed. How should we screen the situation in order to collect crime-related traces and reconstruct what happened? CSIs need critical thinking according to Ribaux et al. (2010). Wyatt (2014) recently published a paper in which he describes how CSIs go beyond the provided guidelines, differentiating the potentially meaningful evidence from the meaningless by thinking like an offender, and through the ability to obtain forensically useful information from victims and witnesses. A well-executed investigation not only includes aspects of scene security, documentation and evidence collection, but it starts with the recognition of crime-related traces during the orientation phase of the investigation (Inman & Rudin, 2001; Lee & Pagliaro, 2013). Protocols in handbooks give guidance in the search for traces, but just using them without thinking would result in extensive amounts of irrelevant traces (Inman & Rudin, 2001). To our knowledge, no study has been conducted on methods that optimise or improve the discovery of relevant traces.

Baber & Butler (2012) performed one of the few studies in the area of search strategies used on the crime scene. They explored how novices and experts investigated two mock crime scenes and categorised the statements of the participants in four types: reference to the modus operandi, reference to the objects in the room, reference to analysis and reference to the room's features. These authors found that novices reported and checked more objects at the scene and focused on objects that could be related to the crime. Novices thereby attempted to reconstruct the event. Experts, on the other hand, focused more on objects that could be used as evidence and thus could help convict the offender. Experts are better in drawing inferences about the state of the environment under scrutiny in terms of selecting 'good' places to recover evidence. They seem to be more focused on finding successful perpetrator traces. Case history seems to be used to determine the relevance of cues (Baber & Butler, 2012). Although the results give an

important first insight into search strategies used by expert CSIs, Baber and Butler do not examine whether all crime-related traces were discovered. It is therefore unclear whether the search behaviour of experts is to be preferred over the behaviour of novices. Focusing on perpetrator traces might result in overlooking other crime-related traces.

2.1.4 The influence of new technologies

As explained, visual attention can be controlled by the goal of the observer. With the integration of rapid identification techniques at the crime scene, the goal of a CSI might shift from reconstructing what happened (Fisher & Fisher, 2012) to finding specific traces that can be analysed rapidly with those new devices, such as DNA traces or fingerprints. The use of a spectral camera that can visualise blood traces might shift the focus of a CSI to blood traces, and to specific areas that can be examined for the presence of blood with such a camera. A shift in focus to specific traces might help find traces that would otherwise be overlooked, but the drawback could be a disproportionate focus on DNA or blood, at the expense of finding other important traces. A further consequence could be an overload of traces that are suitable for the technique, but which are not crime-related. In other words, it is hypothesised that CSIs with rapid identification techniques at their disposal will pay more attention to objects that could contain DNA or fingerprints than CSIs without this technology. Likewise, CSIs with a spectral camera will pay more attention to objects or surfaces that could contain blood. CSIs equipped with one the two technologies are therefore expected to pay less attention to discriminating between crime-related and nonrelated traces. To test these hypotheses, a mock crime scene was set up with different conditions to investigate the influence of the new technologies on the focus of CSIs. A number of CSIs were asked to inspect the scene.

2.2 Method

The study was conducted at a mock crime scene in a 'crime house' that allows video and audio recording. Using a 'crime house' made it possible to set up the same crime scene for each participant. In this way, the course of the crime scene investigation of various individual CSIs could be studied. For each individual CSI taking part, the investigation started with a briefing in which the study was explained, and a short account of when the crime was discovered. Next, the CSIs were sent to the crime scene with a member of the research team who posed as a trainee CSI, to conduct the investigation. Overall, the CSIs assumed they had to learn the trainee more about crime scene investigations. The trainee's role was to gain information on the thought processes of the CSIs. Another

member of the research team played the role of the uniformed police officer present at the crime scene. The participating CSI could ask the officer all kinds of questions to gain information on the victim, the crime scene, witnesses etc. The police officer pretended to have been the first person to arrive at the crime scene. She told the participant that she had found the victim, who had then been taken to hospital and was too upset to provide any information about the crime. After one hour at the crime scene, the participant received information about the victim's wounds and clothing from 'colleagues' who were supposedly at the hospital. At that time, the victim was said to still be unable to make a statement. Each participant was instructed to search the crime scene and secure traces, just as they would do in real investigations. Consequently, they had to decide which traces they wanted to be analysed and which they kept in storage.

The mock crime scene used here and the way CSIs are followed, interrogated and observed during their investigation of the scene has been designed and developed as part of a larger research programme at the Amsterdam University of Applied Sciences (HvA) about behaviour at the crime scene. It is a joint production of the first author of this paper and Anna Mapes (HvA), whose research within this programme focuses on mobile DNA technologies. Data collection required a staff of 4 persons, and was a joint effort by the whole team of the overall project. The present article analyses a part of these data only.

2.2.1 The experimental crime scene

The researchers in our group created a mock crime scene in the CSI-lab of the academy of the Netherlands Forensic Institute. The researchers created the scenario. The simulated crime was an armed robbery committed by two co-offenders. The crime was composed of elements from several real-life cases. An armed robbery with serious consequences was chosen, to ensure that the goal of the participants would be to find all relevant traces. (In high-volume crime cases, efficiency, searching for obvious traces in a short amount of time, is more important than completeness, and in these cases a CSI concentrates on the specific spots that offer the highest chance of finding crime-related traces, such as the point of entry (Van Amelsvoort & Groenendal, 2013). The crime scene consisted of a street, a hall, a living room, a bathroom and a bedroom. An observation room is positioned next to the crime scene. From here, the researchers could follow the participants at the crime scene on cameras and audio. Figure 2.1 shows the floor plan and photos of the area in the CSI-lab.

The mock crime had been re-enacted with actors, who followed a detailed scenario to make sure that traces would be left in realistic places. Some traces were more difficult to find than others. In total the researchers planted 18 traces, 12 of them crime-related, 6 not crime-related. An object was scored as crime-related if it had a direct link with our

scenario and could possibly contain traces of the offender, such as blood on the bedroom floor, a tie-wrap or tape. As designers of the crime scenario, the researchers know the ground truth in this case. The researchers also constructed non-crime-related traces that were not caused during the event. As an example, bottles of beer or cigarettes left at the scene.

Moreover, some of the traces at the scene were particularly interesting for investigators with access to the rapid ID, and there were also traces that would interest those who with a spectral camera, in order to test the expected change in visual attention. Traces interesting for the rapid ID group could for example contain DNA, or display fingerprints (the researchers planted 12 crime-related traces and 5 non-crime-related ones of this type); traces interesting for those with a spectral camera were objects that could contain blood traces or had a dark surface (the researchers constructed 5 crime-related and 2 non-crime-related traces of this type).

Figure 2.1: Floor plan and photos of the crime house.

2.2.2 Participants

Thirty CSIs from five different police regions were recruited via police management to participate in this study. The thirty participants were divided into three groups: one control group and two experimental groups. The control group had to investigate the crime scene in the traditional way. The first experimental group, the rapid ID group, had the option of using rapid identification techniques for fingerprints and DNA traces. The second experimental group, called the spectral group, had access to a spectral camera which could be used to identify and date bloodstains. The equipment used by the experimental groups is presently not available to CSIs during their normal police work, so

they had no experience with these new technologies. To make sure that differences between the groups would not be affected by background characteristics, all the participants were asked to fill out a questionnaire with background characteristics prior to the start of the study. Based on this information, the participants were divided equally over the groups before the experiments started.

The characteristics of the participants are shown in Table 2.1. The group consists of 20 men and 10 women in an age range of 21 to 61 years (M = 42, SD = 10) and their experience within the forensic investigation department ranged from 2 to 31 years (M = 8, SD = 7). Their experience with cases similar to the case in our study ranged from 0 to 31 years, with an average of 8 years (M = 8, SD = 7). There is no difference in age, region, education, sex and experience between the three conditions. The experimental condition (control, rapid ID, spectral) is treated as explanatory variable.

Table 2.1: Demographic characteristics of participants (N=30).

Characteristics	Total	Percentage
Age		
< 30	4	13.3
31 – 50	19	63.3
> 50	7	23.3
M=42, SD=10		
Sex		
Male	20	66.7
Female	10	33.3
Education		
Secondary school	4	13.3
Intermediate vocational education	15	50.0
Higher vocational or academic	11	36.7
Time spent in forensic investigation department (years)		
<5	11	36.7
5-10	11	36.7
>10	8	26.7
M=8, SD=7		

2.2.3 Procedures

2.2.3.1 Briefing

Each experimental session started with a briefing in which the study was explained. The researchers stated that the goal of the study was to examine decision-making processes of CSIs at a crime scene. It was stated emphatically that the study was not about personal performance and the participants were asked to investigate the crime scene as they

would normally do in practice. For members of the experimental groups, the new techniques available to them were explained, how it could be used, and when they would receive the results. The other few exceptions to their daily practices, such as the individual decisions about when and where the secured traces should be analysed (which are normally made in consultation with colleagues) were explained, and then the study started. Before an individual participant was sent to the crime scene, they were provided with initial information by one of the researchers who pretended to be a member of the police force's emergency room. The information provided: there has been a robbery, witness has seen one offender, victim has been taken to hospital and more information might be obtained from the police officer present at the scene. To control the presentation of the initial information and ensure consistency between all participants, all the information that could be provided to the subjects (depending on the questions asked by the participant) was written down and literally recited by the researcher.

2.2.3.2 Police officer at the scene

A mock uniformed police officer at the crime scene, who actually was a member of the research group, pretended to have been the first person present at the scene, having found the victim. The police officer began by explaining the situation to the CSI as soon as (s)he arrived at the scene. The participants could ask questions in response to the provided information. The participants could also ask the officer questions during the investigation. Participants received the same answers to their questions. After one hour, the officer received a phone call from a (mock) detective allegedly at the hospital with the victim. This colleague provided information to the CSI concerning the wounds of the victim and the clothing he was wearing.

2.2.3.3 Choices and decisions

To gain insight into the choices and decisions made by the CSIs, the thought processes of the CSIs need to be identified. Since the CSIs did the investigation individually, the researchers considered using the 'thinking out loud' method (Van Someren et al., 1994), but in the end decided that this would make the investigation feel less natural, which might affect the data. The decision was therefore made to work with a 'trainee', also a member of the research team, who would visit the crime scene with the CSI. Each participant was asked to explain his or her approach and actions to the trainee and to tell the trainee what they observed and thought while conducting the investigation. The trainee could also ask the participant about his or her thoughts and decisions, with questions such as "what are you looking at?", "why are you doing that?". The questions

were designed to be as objective as possible to not influence the participants' decision-making. Most of the participants (73%) were used to working with a trainee in practice.

Next, the participants were asked to decide about the purpose of the secured traces. Boxes were placed at the crime scene in which traces could be deposited after securing them. Participants could choose between a box to send the trace to a forensic lab for analysis and a box to keep it in storage. The rapid ID experimental group, which had the option of analysing the traces for rapid identification, had an additional box labelled 'rapid identification'.

2.2.3.4 Mobile laboratory

The participants in the two experimental groups had a simulated mobile laboratory with a laboratory worker on the scene. The laboratory worker was a member of our research team. The participants of the rapid ID group had the option of sending their traces to the mobile lab for rapid identification. The laboratory worker provided the results of the analyses of fingerprints in fifteen minutes and of DNA in thirty. The spectral group could use a real spectral camera to detect blood and receive an indication of its age. The laboratory worker provided the results of the spectral camera in fifteen minutes.

2.2.4 Data analysis

All recordings of the commentaries of the CSIs during the orientation phase were manually transcribed. Most of the participants left the crime scene after their orientation to make a plan of approach. In these cases, the traces mentioned in the plan of approach were scored as seen by the participant. The traces mentioned in the plan of approach were not included if the plan was made after the orientation phase, during an additional round in the apartment. For a minority of the participants there was no apparent distinction between the first two phases; they seemed to perform their orientation and their plan making simultaneously. In these cases the orientation phase lasted until they started preparing for phase 3: the executive phase. After transcription, all the possible traces were checked and it was determined whether or not the participant had mentioned the trace. A trace, or an object with traces, was coded as 'seen by the participant' when the participant mentioned the trace.

2.2.4.1 Score traces

For each trace planted by the researchers, it was registered whether or not a CSI detected the trace. Note that missing a crime-related trace should count as an error, while missing a non-crime-related one is not classified as an error. Some traces that were mentioned separately by some participants have been grouped together. For example, a coffee cup,

a glass and a plate were grouped together as dishes and different pieces of tape are grouped as tape in general. Not unexpectedly, some CSIs considered objects on the scene not planted there by the researchers as relevant traces as well. Summed over all subjects, this happened with 21 nonplanted traces. These objects were part of the interior of the apartment and had no link with the crime; they were not placed at the scene as a potential trace. One can think of objects as a biscuit tin, a jacket, clothes or contents of the trash. These 'traces' were coded as non-related-non-traces. Hence, the totality of traces was divided into three categories: crime-related traces (12, of which 12 suitable for rapid ID and 5 for a spectral camera), non-related traces (6, of which 5 suitable for rapid ID and 2 for a spectral camera), and non-related-non-traces (21). Within the non-related-non-traces, there are 12 traces suitable for rapid ID and 4 traces suitable for the spectral camera.

Two analyses were conducted: a qualitative analysis in which reasons for using a technique were addressed, and a quantitative analysis in which the attention of the CSIs was investigated. First, a qualitative analysis was conducted in which the reasons for using the spectral camera as well as the reasons for analysing traces were coded by the researcher. Regarding the use of the spectral camera, the entire orientation phase was analysed, but this is not the case for the analysis of reasons for using the rapid identification techniques. Participants did speak about potential places at the entire crime scene where the camera could be used, during their observation. The analysis of the reasons for analysing traces with the rapid identification techniques concentrated only on the traces found outside the apartment. Based on the qualitative data, it is possible to investigate which traces were mentioned by the CSI and which not, but during the orientation phase it mostly remains unspecified whether the CSIs wished to analyse the traces. Generally, traces found outside the apartment should be secured directly due to special circumstances such as weather conditions (Van Amelsvoort & Groenendal, 2013). Usually, decisions about securing these traces and analysing them are therefore already made during the orientation phase. For this reason, the qualitative analysis concerning the use of the rapid identification techniques focused on the traces found outside the apartment. Comments made about traces found inside the apartment mostly did not contain information about choices concerning the analysis of traces. Inductive thematic analysis was used to discover search patterns of CSIs in the data, and the reasons for using both techniques were coded (Braun & Clarke, 2006).

The next, quantitative analysis investigates the traces mentioned during the entire orientation phase to analyse the focus of the CSIs. The dependent variables 'percentage of crime-related, nonrelated and non-related-non-traces mentioned' were analysed with an analysis of variance (ANOVA) as well as 'percentage rapid ID-traces mentioned and

spectral–traces mentioned' to study the influence of the new technologies on the attention of the CSIs.

2.3 Results

2.3.1 Qualitative analysis of comments made

The comments made by the CSIs during the investigation give us insight into their reasoning processes, so these comments were analysed to explore the focus of the participants during the orientation phase. This information can specify when and why traces will be analysed. Based on this information, it seemed that the spectral camera induces a focus on dark surfaces. Furthermore, the participants of the rapid ID group seemed to focus on analysing perpetrator traces with the rapid identification techniques.

2.3.1.1 Dark surfaces

Although none of the participants actually used the camera during the orientation phase, five of them considered where to use it during a later phase of the investigation. As the camera allows the participants to detect blood on, for example, dark surfaces, four of the ten participants seemed to concentrate on dark surfaces during the orientation. Quotes of the participants illustrate this effect:

"*I have the possibility to use the spectral camera. I would like to use it for the bed to see whether the duvet contains blood that is not directly visible. It is a dark surface.*" [Participant 8]

"*There are dark things on the bed. Interesting for spectral camera.*" [Participant 13]

"*I could have a look with the camera to see if there is blood on the dark surfaces. Visually, I see nothing, but there could be blood here. For example, on the clothes next to the blood swipes on the floor.*" [Participant 25]

In our scenario, the duvet and clothes did not contain any bloodstains. The possibility of the victim being tied up in bed was mentioned once within the control group. Some participants within the control and rapid ID group mentioned the fact that the bed looked like someone had slept in it. One of the participants in these two conditions indicated the need to search for blood on the duvet. The participants of the spectral group seemed to

consider more objects, especially ones with dark surfaces, important in their reconstruction.

2.3.1.2 Perpetrator traces

Four participants in the control group, four participants in the rapid ID group and two participants in the spectral group secured traces found outside during the orientation phase. Although not all participants described their thoughts about possible analyses, a glimpse of their thought processes shows a focus on analysing perpetrator traces. Two participants in the control group decided to have their secured trace analysed because they believed the trace to be from the perpetrator. The same goes for one participant in the spectral group. Four of the ten participants in the rapid ID group explained when they would analyse a trace with the rapid identification technique. Here, the focus was also on analysing perpetrator traces, more so than on testing hypotheses. Participant 21 illustrated this finding as follows:

"*The victim may have lost his keys, maybe the offenders opened the door. In that case you have their DNA on it. No hurry since we don't know yet."*

These four participants actually decided to bring a trace to the mobile lab for analysis during the orientation. These traces were found outside the apartment: a balaclava was sent in for quick analysis three times and a set of keys found in the front door once. The participants expected these to be perpetrator traces. Participant 28 illustrates this with his quote about the keys:

"Someone might have found the keys. That's also a plausible scenario. I have seen that before. […]. The neighbour didn't put the keys in the door, neither did the police officer. I would like to analyse the keys for DNA traces."

In our scenario, the traces on the keys were not from the offender.

Generally, uncertainty about the value of the trace was a reason *not* to analyse the traces found outside. Participants weren't certain whether the perpetrator left these traces. Since not all the participants secured traces and thought about the analysis of traces during the orientation phase, it is not possible, based on the orientation phase, to say whether the focus on perpetrator traces is a common finding.

2.3.2 Crime-related and nonrelated traces

In order to investigate whether there are differences in the number and kind of traces mentioned between the experimental groups, a quantitative analysis was conducted. For ease of comparison over the three types of traces ("crime-related traces" n=12, "nonrelated traces" n=6, "non-related-NON-traces" n= 21) we converted the numbers found to percentages, noticing that the base number of these percentages is rather small and moreover different over categories. Table 2.2 shows the mean percentages and their standard deviations of the mentioned traces within the three categories, as well as the results of an ANOVA analysis.

Table 2.2: Mean percentages and standard deviations of mentioned crime-related traces, non-related traces and non-related-non-traces by the control group, the rapid ID group and the spectral group.

	Control	Rapid ID	Spectral	ANOVA*
Mean percentage of crime-related traces	73.3 (SD=11.0)	80.8 (SD=13.6)	80.0 (SD=11.9)	$F_{2,27} = 1.13$, n.s.
Mean percentage of non-related traces	36.7 (SD=13.1)	40.0 (SD=16.1)	45.0 (SD=20.9)	$F_{2,27} = 0.61$, n.s.
Mean percentage of non-related-NON-traces	28.6 (SD=18.5)	23.3 (SD=14.6)	28.1 (SD=18.3)	$F_{2,27} = 0.28$, n.s.

* For all ANOVAs we first checked homogeneity of error variances in the three conditions, by means of Levene's test. Homogeneity was never rejected ($\alpha = 0.05$).

Compared with the control group, we see within the two experimental groups (rapid ID and spectral conditions) a slightly higher mean percentage of traces mentioned for traces planted by the researchers (both crime-related and non-related ones), but the differences are not significant. We have to conclude that no differences could be established. We venture, however, that the lack of significance may be an effect of the rather small numbers of observations, as estimated effect sizes are not altogether absent. The largest estimated 'between condition mean differences' are of the order of half a (between subjects) standard deviation, which according to Cohen's standards would have to be classified as an intermediate effect size, if it could have been established as significant (Cohen, 1977). There is no sizeable difference between the three groups in the number of non-related-non-traces mentioned during the orientation phase (maximal mean difference is less than 1/3 SD).

Further examination of the data shows that there is even not much difference in the *kind* of traces most often mentioned by subjects in the three conditions. Almost all participants mention the following crime-related traces: the gloves found in the bedroom (n=29), the keys in the front door (n=28), the bloodstain on the bathroom door (n=28),

the tie-wrap (n=28) and the safe in the bedroom (n=28). Three of these five traces are found in the bedroom, the place where the victim was found. Examples of frequently mentioned non-crime-related traces are cigarettes (n=27) and empty bottles of beer (n=23). To our surprise, there was one crime-related trace that was missed by mostly all the participants in the three conditions: a bloodstain linked to an offender.

The large standard deviations mentioned in both control and experimental conditions suggest that there are large differences between CSIs with respect to traces they perceive and mention, irrespective of experimental condition. This may indicate that, in general, CSIs have different search styles and differ in extensiveness during the orientation phase of the investigation. Such differences, however, cannot be attributed to the use of new technologies.

2.3.3 Traces suitable for new techniques

In this section, we compare what CSIs do with traces that may suitably be subjected to a new technique and those that are not. This is done for both the rapid ID technique and for the spectral camera technique. It would have been nice to be able to do this separately for the three types of traces (crime-related, non-related, and non-related-non-traces), but the number of traces available does not permit such a fine-grained subdivision. We therefore analyse all 39 traces together. Twenty-nine traces are considered especially suitable for the rapid ID condition as they may contain DNA or fingerprints (called "RI suitable traces"), while 10 are not especially suitable for rapid ID. Further, 11 traces are considered as suitable for spectral camera investigation ("spectral camera suitable"), while the other 28 are not. Table 2.3 shows the mean percentages and standard deviations of the mentioned traces by the three conditions. Additionally, the results of an ANOVA analysis are presented.

Table 2.3: Mean percentages and standard deviations of mentioned rapid ID (RI) traces and spectral (SP) traces.

	Control	Rapid ID	Spectral	ANOVA*
Mean percentage of rapid ID suitable traces found	48.3 (SD=11.0)	49.0 (SD=11.5)	50.3 (SD=13.4)	$F_{2,27}$ = n.s.
Mean percentage of spectral camera suitable traces found	39.1 (SD=12.9)	41.8 (SD=12.3)	42.7 (SD=17.7)	$F_{2,27}$ = n.s.

* For both ANOVAs we first checked homogeneity of error variances in the three conditions, by means of Levene's test. Homogeneity was never rejected (α = 0.05).

The data in table 2.3 show no differences between the three conditions in the numbers of traces mentioned that are either interesting for rapid ID techniques or the spectral

camera. Overall, the focus of the three conditions does not seem to be influenced by the use of technologies. Although certain traces could be explored with particular techniques, the users of these techniques do not mention these traces more often than other participants. The kinds of traces mentioned varies within the entire group of participants, and again, the results show a large variation within the conditions.

2.4 Discussion

This study explored the influence of using new technologies at the crime scene on the visual attention of CSIs during the first orientation phase of the investigation process. A qualitative analysis reveals a small effect of the techniques, but a corresponding quantitative analysis does not confirm such differences in the visual attention of CSIs caused by the technologies, as participants in the experimental conditions mentioned the same number and kinds of traces as participants in the control condition. Thus, contrary to what was expected based on the theory of (Chun & Wolfe, 2008), the new technologies did not influence the overall attention of the participants. The orientation phase was conducted like the CSIs would normally do without the use of the technologies, which is actually a reassuring finding. In their search, the CSIs are not directed by the new technologies, even though these technologies could be used to explore or analyse specific kinds of traces.

The qualitative data suggest that the possibility of the spectral camera to detect blood on dark surfaces triggered CSIs to focus more on dark surfaces. In their motivations, the CSIs did give the impression that they were more focused on possible perpetrator traces that could be analysed quickly, than on reconstructing the crime and testing different hypotheses. In fact, to test hypotheses, traces should not only be analysed when surmised to be from the suspect, but also if they could be from the victim or from someone else. Although rapid identification techniques could in principle be used to reconstruct the event with rapid feedback on the source of traces, they seemed to be used differently in practice. Instead of reconstructing the event, participants seemed to be focused on new technological possibilities. They seemed to overlook the importance of traces for the reconstruction of the event, by mainly analysing dark surfaces when they have a spectral camera or, in general, by only interpreting traces as important if they are believed to be from the perpetrator. Such a focus would mean that crime-related traces could be found, but might be labelled as irrelevant if not interpreted as perpetrator traces. These qualitative findings may be strengthened and confirmed during the executive phase of the crime scene investigation (not yet analysed in this article) when

more traces are secured and when participants in the experimental condition can analyse more traces using the specific technologies. Such a result would correspond with the findings of Baber & Butler (2012) that expert CSIs search for evidence instead of reconstructing the event. The question is, especially with the use of rapid identification techniques, whether such behaviour is advisable. A strategy in which the CSIs hunt for perpetrator traces suitable to the rapid identification technique might result in finding perpetrators at a very early stage in the investigation, which would be a very positive consequence of the technique. However, it can also become a risk if other crime-related traces are overlooked or neglected, and if analysed traces are in fact not crime-related and instead lead to the rapid identification of innocent suspects. Cognitive processes such as confirmation bias can result in an investigation centring on this innocent person, with potentially serious consequences (Nickerson, 1998). This risk can be even greater as long as no other information is available yet, as information acquired early on in the investigation is likely to carry more weight than information acquired later (Nickerson, 1998). Furthermore, rapid identification information of assumed perpetrator traces can cause an unjustified feeling of satisfaction: when a match is found, CSIs may think that they have the offender.

To our surprise, the results also showed large variations within the three conditions. Even though all the participants investigated the same crime scene, there are large differences in how they conducted the orientation. There seems to be a difference in style: some participants take relatively more time, conduct an extensive observation of the crime scene, identify more possible traces and seek to collect a good amount of information. Others take less time for the orientation and mention fewer crime-related, but also fewer non-crime-related traces. Different approaches thus seem to be present already in the orientation phase of the investigation process. It is not known yet whether CSIs who missed crime-related traces during the orientation phase will find these traces during the forensic examination (phase three of the investigation). Investigating the effects of different methods for crime scene investigation could help to identify best practices and to support the development of validated CSI-methods. The crime scene investigation is an extremely important part of the criminal investigation process as a whole, as the first decisions are made at the crime scene.

Notice that the large standard deviations within the experimental groups may have hampered any finding of differences, if they exist, as this affects the power of comparison. Larger sample sizes of CSIs would be helpful to determine this, but given the enormous investment of time and effort by CSIs and researchers in the present investigation, this seems unfeasible at this point.

This paper only addressed the orientation phase of the crime scene investigation. Although the focus of a CSI is determined during this orientation phase, the data only show a glimpse of the participants' considerations concerning the further analysis of the perceived traces. Analysing the entire investigation would provide more insight into the considerations and final decisions of CSIs concerning the securing and analysis of traces during the entire investigation process. If the CSIs start hunting for perpetrator traces suitable to the rapid identification techniques, then it is important to understand how this influences the interpretation of the crime scene and its traces. In subsequent articles, further stages in the entire crime scene investigation process will be analysed. Unique to this study is that the ground truth is known, which allows the researchers to test the results of the strategy used during the investigation.

Although this study provided interesting first insights into the influence of new technologies on CSIs' search behaviour and thought processes, the study also has its limitations. One limitation might be that its outcomes depend on the communication style of the CSI conducting the investigation. Ideas about what crime scene officers do and do not perceive are based on what they do and do not mention. However, people may differ in the extent to which they communicate the traces they perceive. This may influence our ideas about the CSI's perceptions. To overcome this difficulty, a trainee asking clarifying questions was used. The CSIs were asked to inform the trainee about what they saw and thought, and the trainee actively asked for this information. Questions put by the trainee forced the CSIs to make their thoughts explicit. Another possible limitation connected with this one is that CSIs can work either in teams or individually. In the Netherlands, in cases of violent robberies it varies between regions whether a CSI works individually or in a team. Working together with another CSI might generate different results as other processes such as the interaction between persons or habits within regular teams can also be of influence. Nevertheless, it is important to understand individual performances as limited research has been conducted on CSI performances. Studying team performances would be interesting for follow-up studies.

A further limitation could be that the crime scene investigations were conducted at simulated crime scenes. Whether the results found in a lab are an accurate reflection of what happens in real life, and thus to what extent the results of a lab-study can be generalised, is a perennial question. According to the CSIs who participated in this experiment, the fact that they conducted their investigation at a mock crime scene did not influence their behaviour. They claimed that they would have acted the same if this had been a real-life case.

A last but important limitation might be that the participants are asked to use the new techniques without knowing exactly how these would work in practice, since the

techniques are not yet operational. Asking participants to use techniques that are not yet used in practice could cause participants to not take the experiment seriously, or to misinterpret the possible utility of the techniques. The fact that no quantitative differences were found may indicate that this method has flaws and that participants indeed did not take the techniques seriously. However, both the qualitative and the quantitative data show that participants do what they would normally do during the orientation and that they do consider using the technologies in a serious way. Replications of the experiment might be useful to test the robustness of the results.

This first study shows the importance of further research into the use of new techniques at the crime scene and crime scene investigations itself. Insights into thought processes show that new techniques can have a strong influence on a CSI's investigation, particularly the rapid identification techniques. A focus on perpetrator traces can subsequently influence an entire police investigation. Future research should focus on the complete crime scene investigation, to investigate both the influence of the 'perpetrator-strategy' and the possibility of deriving best practices from the different strategies used to investigate a crime scene. This way, this study may contribute to the development of knowledge-based protocols for crime scene investigations.