Memory-based Lie Detection in Repeated Interviews: The Importance of Early Use of Mnemonics

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Dedicated to my parents Sabina & Vladimir
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“All of this, down to the smallest detail, can be explained if you wish in an entirely different way, and it would sound even more natural.” (Dostoevsky, 1866)

**General Abstract**

The aim of this thesis was to examine how different memory-enhancing (mnemonic) techniques used in an interview carried out immediately after an event affected truth tellers’ and liars’ responses in the immediate interview and also in a delayed interview. In Studies I-III participants took part in a specific mock intelligence scenario in which they were asked to take the role of an intelligence officer. They were shown a mock intelligence operation video of a secret break-in to an apartment. Participants were instructed either to tell the truth or lie about its contents in two interviews, one of which was immediately after watching the video and the other after an approximately two-week delay. The amount of visual, spatial, temporal, and action details, and between-statement consistency characteristics between the two interviews (reminiscences, repetitions, and omissions) in truth tellers’ and liars’ responses were analysed.

In Study I ($N = 143$), three mnemonic techniques were tested: Context reinstatement, Sketch, and Event-line. In the immediate interview, participants were asked to provide a free recall and then asked to give further information via one of these three mnemonics. In the delayed interview, they were only asked to provide a free recall. Truth tellers reported more visual, spatial, temporal, and action details in the immediate and delayed interviews, regardless of which mnemonic technique was used. Truth tellers experienced more of a decline in reporting details after a delay than liars, thus showing more than liars, patterns of reporting indicative of genuine memory decay. Truth tellers and liars did not differ in terms of between-statement consistency.
In Study II ($N = 49$), the effects of the Sketch mnemonic on truth tellers’ and liars’ immediate and delayed responses were examined. Unlike Study I, in this experiment a free recall phase was not included in the immediate interview. Participants were only asked to draw a sketch of the apartment of the break-in, and to describe that sketch. In the immediate interviews, truth tellers reported more visual, spatial, temporal, and action details than liars. In the delayed interviews, truth tellers reported more spatial, temporal, and action details than liars. Truth tellers and liars reported a similar number of visual details in the delayed interviews. As in Study I, truth tellers more than liars, showed patterns indicative of genuine memory decay. Between-statement consistency did not differ between veracity groups.

In Study III ($N = 80$), the effects of different interviewing techniques used in the immediate interview on truth tellers’ and liars’ delayed responses were examined. In the immediate interview participants were instructed either to report everything they remembered, or asked open-ended spatial questions related to the event. In the delayed interview all participants were asked to report everything they could remember. Truth tellers reported more visual, spatial, temporal and action details than liars, both immediately and after a delay, regardless of the interview technique used in the immediate interview. However, in the immediate interview the differences between truth tellers and liars were larger using the report everything mnemonic than using the spatial questions. Regarding between-statement consistency, truth tellers provided more reminiscences and repetitions and made fewer omissions than liars.

In Study IV ($N = 96$), participants read the immediate and delayed statements from Study I and were asked to make veracity judgements. One group of participants was informed about the findings of Study I, and instructed to rely on these findings when making their veracity judgements. The other group was not informed about the findings of Study I. Results showed that deception detection accuracy did not differ between the informed and
uninformed groups. In addition, the majority of participants in both conditions based their decisions on unreliable cues to truth/deceit.

The results of this thesis demonstrate that the way an interview immediately after an event is carried has an effect on later interviews, when it comes to discriminating between truthful and deceptive accounts. Practitioners need to be aware that it is important to conduct the first interview as soon as possible after an incident, and to use interview techniques that enhance complete statements from the interviewee in order to effectively detect deception in the further stages of the investigation.
Declaration

“Whilst registered as a candidate for the above degree, I have not been registered for any other research award. The results and conclusions embodied in this thesis are the work of the named candidate and have not been submitted to any other academic award”.

Aleksandras Izotovas

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Oral Presentations


Poster Presentations


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Chapter 1: General Introduction
Deception is very much part of human behaviour. People lie because it is important for their survival (Goffman, 1959). Indeed, renowned German philosopher Friedrich Nietzsche argued that deception is necessary for our social existence (Nietzsche, 1896, as cited in Kaufmann, 1994). Modern research based on empirical evidence suggests that people lie to avoid bad feelings, to make positive impression on others, to gain psychological or material advantage, and/or avoid negative consequences (DePaulo, 1992; Vrij, 2008). In forensic settings, the latter motive is the most significant one. Interviewees may lie to protect themselves or others from punishment such as many years of incarceration. To examine effective ways to detect deception in criminal justice contexts is important for two reasons. First, the question of witness or suspect credibility is important for investigative and forensic professionals (Volbert & Steller, 2014; Vrij, 2015; Zöhner, 2011). Second, poor accuracy in deception detection may have severe consequences. An innocent person wrongly identified as telling a lie can falsely be convicted for the crime(s) she/he did not commit (Kassin, 2015). Conversely, a deceptive person wrongly identified as telling the truth could escape conviction and continue committing further crimes.

The main question that arises is how can truths be distinguished from lies? In the second part of the last century, research in human behaviour mostly concentrated on the non-verbal cues that could potentially indicate deception (Ekman & Friesen, 1969; Miller & Stiff, 1993; Zuckerman, DePaulo, & Rosenthal, 1981). The motive to investigate non-verbal behaviour stemmed from the common stereotypical view that lying is morally wrong (Bok, 1978; DePaulo, Kashy, Kirkendol, Wyer, & Epstein, 1996; Robinson, 1994). If deception is considered morally wrong, then liars’ behaviour should be accompanied by typical reactions of nervousness, for example, gaze aversion or body movements (Inbau, Reid, Buckley, & Jayne, 2001). However, several meta analytical studies have shown that non-verbal cues to deceit are unreliable, with discrimination accuracy between truth tellers and liars typically not
much higher than chance level (DePaulo et al., 2003; Masip, Sporer, Garrido, & Herrero, 2005; Sporer & Schwandt, 2006). Moreover, these studies have demonstrated that verbal cues are more accurate than non-verbal cues. Among one of the most diagnostic verbal cues typically found in deception research is the amount of detail reported (Amado, Arce, Fariña, & Vilarino, 2016; DePaulo et al., 2003; Vrij, 2008). That is, the more detailed the response of an interviewee is, the more likely it is that the response was truthful, and vice versa.

Although the amount of details reported has been identified as one of the key cues to detect deception, in most studies interviews are conducted only once, typically immediately after an event (Vrij, 2008, 2016). However, in real-life forensic settings, the same person (crime victim, witness, suspect, or other source of information) is commonly interviewed about the same event more than once and at different points in time (Goldsmith, Koriat, & Pansky, 2005; Innes, 2000; Wysman, Scoboria, Gawrylowicz, & Memon, 2014). For example, a police officer may question the same suspect repeatedly to search for contradictions between his/her statements.

Apart from time delay and the number of interviews conducted about the event in question, the diagnostic value of the cue ‘amount of detail’ can be affected by the questioning technique used during the interviewing. Researchers have shown that using specific techniques is more effective in eliciting verbal differences between truth tellers and liars than standard question-answer approaches (Hartwig, Granhag, & Luke, 2014; Mac Giolla, Granhag, & Vernham, 2017; Vrij, Fisher, & Blank, 2017). One of these fruitful techniques is memory-enhancing techniques, also called mnemonics (Fisher & Geiselman, 1992). Examination of mnemonic techniques is important because they are typically included in evidence-based investigative interviewing guidelines (Achieving Best Evidence in Criminal Proceedings, 2011; Meissner, Surmon-Böhr, Oleszkiewicz, & Alison, 2017). Previous studies have shown that use of mnemonics can be beneficial in detecting deception (Bembibre &
Higueras, 2011; Hernández-Fernaud & Alonso-Quecuty, 1997; Vrij et al., 2009). However, not many studies have focused on how they affect the amount of detail as a credibility cue in repeated interviews, which take part over a certain period of time. The use of mnemonic techniques in the immediate interview and their effects after a delay to detect deception is the main focus of this research.

This thesis contains six chapters: In Chapter 1 (General Introduction), an overview of theoretical background and empirical evidence related to the topic of this research is presented. In Chapters 2-5 (Studies I-IV), the studies conducted in this thesis are presented. Finally, the overall findings of the thesis are discussed, and empirical considerations, practical recommendations, and conclusions are provided in Chapter 6 (General Discussion).

1.1 The thesis

In this thesis, the focus is on two periods of time of interviewing: Immediate, and after two-week delay. Previous research has demonstrated that high-quality (i.e., eliciting complete and accurate accounts) immediate interviewing can be beneficial for the delayed performance of truth tellers (e.g., inoculate against forgetting and result in less errors) than lower quality immediate interviewing (Bornstein, Liebel & Scarberry, 1998; Hope, Gabbert, Fisher, & Jamieson, 2014; Pansky & Nemets, 2012). In the current thesis, expansion on this knowledge is sought by examining whether high-quality immediate interviewing (i.e., using mnemonic techniques) can also be helpful to detect deception after a delay.

The research conducted for this thesis is an effort to extend our theoretical and practical knowledge of deception detection in repeated interviewing across a passage of time using mnemonics. Regarding the theoretical perspective, the thesis contributes to the understanding of the reporting of information between immediate and delayed interviews by
truth tellers and liars. Do the patterns of reporting over time differ between truth tellers and liars? In other words, is the reporting of fabricated information similar to the reporting of information retrieved from memory of genuine experience(s), across the passage of time? From a practical perspective, this thesis is an attempt to examine whether mnemonics used in the immediate interviews could be helpful to distinguish between truthful and deceptive responses immediately and after a two-week delay.

The thesis opens with an overview of theoretical background and empirical evidence related to the topic of this research. Specifically, Chapter 1 proceeds with Key terms and definitions (section 1.2) associated with memory and deception theories that were relevant for this research. Then, in a section 1.3 Information-gathering interviewing different investigative interviewing approaches used in the criminal justice systems around the world and their relevance to lie detection are discussed. The next two sections are related to interviewing to detect deception: in 1.4 Verbal deception detection: Cognitive Credibility Assessment a theoretical rationale of the verbal differences between truthful and deceptive statements are provided, and several verbal lie detection interviewing techniques are introduced, and in 1.5 Detecting deception with mnemonic techniques how using memory-enhancing techniques in interviews can contribute to verbal deception detection is reviewed. The following two sections are related to repeated interviewing. First, to understand how real memories are processed, the section 1.6 Memory and repeated interviewing: The role of initial interviewee’s account on delayed performance discusses how the quality of immediate reporting of information affects the subsequent truthful interviewee’s responses. Then, in 1.7 Detecting deception in repeated delayed interviewing the differences between truth tellers and liars are reviewed in terms of two veracity cues, amount of detail, and between-statement consistency. The section 1.8 Accuracy in human veracity judgements discusses previous
research regarding laypeople’s and practitioners’ ability to detect truth and deceit. The final section (1.9) of Chapter 1 presents General and specific aims of this thesis.

1.2 Key Terms and Definitions

**Deception.** It is defined as a deliberate (successful or unsuccessful) attempt of a communicator to fabricate truthful information and present it to another person, without forewarning, with the purpose to make him/her believe that this information is true (Vrij, 2008). The terms deception, deceit, lie, or fabrication will be used interchangeably in this thesis.

**Interviewing.** In the criminal justice system, a distinction has been made between interviewing in law enforcement and intelligence-gathering settings (Evans, Meissner, Brandon, Russano, & Kleinman, 2010; Redlich, 2007). Law enforcement interviews are related to the questioning of a witness, victim, or suspect about a crime that occurred in the past. Intelligence interviews involve information-gathering from a source (e.g., informant) about the past, present, or possible upcoming criminal activities, which may not necessarily involve wrongdoing(s) by the source (Kelly, Miller, Redlich, & Kleinman, 2013). These two settings were not differentiated in the thesis. Verbal deception detection requires a certain level of cooperation from the interviewee (Vrij, 2015). It is impossible to assess credibility based on verbal cues when an interviewee does not say anything (e.g., a witness claims s/he ‘does not remember anything’ about the event, or a suspect who exercises his/her right to remain silent). Although the studies of the thesis involved intelligence gathering scenarios as a stimulus material, research findings of the thesis could be applied to different real-life interviewing settings, as long as the interviewee produces speech.
**Mnemonic techniques.** Memory-enhancing (mnemonic) interview techniques are based on two key principles of human memory (Fisher & Geiselman, 1992). First, a memory trace has several features (e.g., visual, physical, or emotional) and the effectiveness of a retrieval cue is dependent on the amount of overlap between the retrieval cue and the encoded event (Flexser & Tulving, 1978). For example, a victim may find the name of the perpetrator difficult to remember when describing the incident, but recall it later when characterising what the offender looked like. Second, several retrieval paths to the encoded event may be available, so that information not accessible with one retrieval cue may become accessible with another (Tulving, 1974). For example, the interviewee may not report specific bystanders seen during an incident when asked a direct question, but may describe them when requested to draw a layout of that room. Four different mnemonic techniques were examined across the experiments conducted for this thesis: i) **Context reinstatement (CR)** (Study I) refers to asking interviewees to mentally recreate the to-be-recalled event, as well as their physiological, cognitive and emotional states at the time of the event (Fisher & Geiselman, 1992). They are typically asked to concentrate, shut their eyes, and ‘put’ themselves back in the situation from the very beginning of it; ii) **Event-line** (Study I) is based on the Timeline interviewing format developed by Hope, Mullis, and Gabbert (2013), which originally used a reporting format with a physical timeline to facilitate memory retrieval of multi perpetrators. The mnemonic is related to reproducing temporal context and sequence of actions in an event; iii) **Sketch** (Studies I and II) refers to making a drawing of a location of the event in question (Dando, Wilcock, & Milne, 2009). Sketching allows interviewees to initiate their own contextual retrieval cues. It is important to clarify the use of the term ‘Sketch’ in this thesis. In the investigative interviewing literature this mnemonic is also known as ‘Sketch Reinstatement of Context’. However, in some sources the term ‘Sketch’ can also be found, (e.g., Hope, Gabbert, & Fisher, 2011; Rivard, Fisher, Robertson,
In the deception literature, the term ‘Sketch’ (or ‘Drawing’) is more common (e.g., Roos af Hjelmsäter, Öhman, Granhag, & Vrij, 2014; Mac Giolla et al., 2017; Vrij et al., 2010). Therefore, it was decided to use the latter. Finally, iv) Report everything (Studies I and III) prompts interviewees to disclose all information they remember, whether it seems trivial or not. Recall of specific details may activate memories of other relevant details (Fisher & Geiselman, 1992; Fisher & Geiselman, 2010).

Retrieval and reporting. Retrieval is the process of recalling information from the past which has been previously encoded and stored in memory (Reber, Reber, & Allen, 2009). This term is not equivalent to reporting of information. Reporting is characterised as verbally presenting the information following the interviewer’s request to do so. If an interviewee does not report specific details about a crime, it does not necessarily mean that s/he is unable to retrieve these unreported items from memory. Retrieval from memory was not examined in this thesis. It was focused on facilitating truth tellers’ reporting, and whether that differed from liars’ reporting of information.

Delay. Also known as retention interval (e.g., Pansky, Koriat, & Goldsmith, 2005). Delay refers to the time from an initial exposure to a stimulus (e.g., witnessed crime) until a later request to recall it from memory (Reber et al., 2009). In forensic settings, the delay time to recall the event in formal interviews can vary significantly (Read & Conolly, 2007). Given the aims of this thesis, here the delay is identified as the time interval (i.e., approx. two-weeks) between the immediate and repeated interview. Therefore, the second (or, repeated) interview is referred to as the delayed interview in this research.

Between-statement consistency. Consistency is defined as the quality of always behaving, performing, or happening in a similar way (Cambridge Dictionary, 2018). In interviewing within legal settings, consistency refers to a match of information within and/or between statements provided by one or a group of interviewees (Granhag & Strömwall, 1999).
Four types of consistency have been identified in the literature: i) consistency between details within one statement, called within-statement consistency; ii) consistency between different statements made by one person, called between-statement consistency; iii) consistency between statements reported by different individuals about the same event, called within-group consistency; and iv) consistency between the statement and evidence, called statement-evidence consistency (Vredeveldt, van Koppen, & Granhag, 2014). As this thesis focused on repeated interviewing, only between-statement consistency was examined. Specifically, changes in the amount of details reported from the immediate to delayed interviews within truthful and deceptive accounts were measured in this thesis. Other types of consistency (e.g. statement-evidence consistency) were less associated with memory-related issues and therefore not measured. Three different (in)consistency characteristics typically used in deception studies were analysed: i) information not mentioned in one statement, but added in a subsequent statement (i.e., reminiscences); ii) information repeated from one statement to another (i.e., repetitions); and iii) information omitted from one statement to another (i.e., omissions; Deeb et al., 2017; Granhag, Mac Giolla, Sooniste, Strömwall, & Liu-Jonsson, 2016; Granhag & Strömwall, 2002). Contradictions, a fourth characteristic, do not occur often enough in most experimental deception research, and were therefore not included in any analyses within this thesis (Granhag et al., 2016).

1.3 Information-gathering interviewing

Credibility assessment in legal settings is usually inseparable from interviewing witnesses or suspects. Therefore, this thesis begins with a brief review of different interviewing approaches that are commonly used in criminal investigations, and their relation to deception detection.
Two main approaches of interviewing in legal settings have been identified: confession-oriented (Inbau, Reid, Buckley, & Jayne, 2013), and information-gathering techniques (Bull & Soukara, 2010; Meissner et al., 2014). The first questioning approach refers to interviews solely with suspects and focuses on obtaining a confession from the suspects. These techniques were derived from the psychological notions of social influence and persuasion (Zimbardo, 1967). The best known confession-oriented interviewing method is the Reid technique, created in 1947 by police officer John Reid in the United States, and revised repeatedly after that (Inbau et al., 2013). It typically includes accusations, manipulations, leading questions, and other psychologically coercive methods. With respect to deception, the Reid technique suggests that innocent and guilty suspects display different non-verbal responses during an interrogation. Suspects in denial (e.g. liars) should display more signs of nervousness, such as fidgeting or gaze aversion (Inbau et al., 2013). However, such claims are inconsistent with scientific research which found no relationship between non-verbal cues and deception (DePaulo et al., 2003; Vrij, 2008; Vrij, Mann, & Fisher, 2006). Examining verbal cues to deceit, which tend to be more effective than non-verbal cues (DePaulo et al., 2003; Vrij, 2008), may be complicated with this approach, because the Reid technique encompasses interruptions and leading closed-ended questions with the only possible answers ‘yes’ or ‘no’. Simply put, this technique does not permit much opportunity to elicit full answers of what happened from an interviewee, which makes the analysis of verbal content difficult (Vrij, Meissner al., 2017). Overall, confession-oriented approaches lack sound theoretical rationale and empirical evidence and are controversial, because they do not meet ethical standards, are linked with false confessions, and are ineffective in terms of detecting deception (Hartwig, Luke, & Skerker, 2016; Meissner et al., 2014; Vrij, Meissner et al., 2017).
The second, information-gathering approach originated in England and Wales. After highly publicised cases of wrongful convictions, the legal framework called the Police and Criminal Evidence Act (PACE) was introduced in 1984. This legal act imposed restrictions on the detention, treatment and questioning of suspects in police custody, and introduced mandatory tape recordings of all interrogations (Code C and Code E; Ozin & Norton, 2015). This approach differs from confession-based interviewing in that it focuses on yielding as much information as possible. In other words, the goal of information-gathering interviewing is to establish an account of what has happened. In this approach the questioning of suspects is similar to that of victims and witnesses: to aid investigators in generating an accurate and complete picture of what has happened (Hartwig et al., 2016). Interviewing techniques related to information-gathering are ethical and based on empirically tested theories about human communication, conversation management, and the psychology of memory (Clarke, Milne, & Bull, 2011). The best known information-gathering interviewing method is called the PEACE model, an acronym identifying five stages of an interview: Planning and preparation, Engage and explain, Account, Closure, and Evaluation (Milne & Bull, 1999). The PEACE model is widely accepted in Western Europe and in some countries outside Europe (e.g., Australia, New Zealand, and Canada; Snook, Eastwood, Stinson, Tedeschini, & House, 2010). It is non-accusatory, focusing on the importance of honesty, rapport building, active listening, and appropriate questioning to search for the truth (Oxburgh, Fahnsg, Haworth, & Blair, 2016). With respect to verbal deception detection, information-gathering interviewing is more useful than the confession-based approach for verbal lie detection purposes. Interviewing techniques related to gathering of information elicit detailed responses from interviewees which subsequently can be used to infer the interviewee’s credibility.

Interviewing techniques (including mnemonics) that fit the PEACE model have been created or adapted for verbal lie detection purposes (Gozna & Horvath, 2009; Vrij et al., 2017).
The next section will provide the theoretical background of verbal differences between truth
tellers and liars and will introduce specific interviewing techniques that contribute to effective
deception detection.

1.4 Verbal deception detection: Cognitive Credibility Assessment

1.4.1 Theoretical background

The theoretical rationale regarding the amount of detail reported as a credibility cue is
based on the assumption that truth tellers and liars have different mental states during an
interview (Gran Hag & Hartwig, 2015; Vrij, 2008). The approach, called Cognitive Credibility
Assessment (CCA; Vrij, 2018), proposes that in interview settings lying is typically more
mentally demanding than truth telling (Zuckerman et al., 1981; Buller & Burgoon, 1996), and
that this difference can be further enhanced through specific interventions (Vrij, 2008, 2015).
Elements that contribute to a liar’s enhanced cognitive load are preparing a convincing story
(Hartwig, Gran Hag, & Strömwall, 2007), suppressing the truth (Verschuere, Spruyt, Meijer,
& Otgaar, 2011), remembering what was said earlier (Gran Hag & Strömwall, 1999),
controlling their verbal and non-verbal behaviour (DePaulo & Kirkendol, 1989; Baumeister,
1998), monitoring an interviewer’s reactions (Buller & Burgoon, 1996; Schweitzer, Brodt, &
Croson, 2002), reminding themselves to act and role-play (DePaulo et al., 2003), and
providing justification for their lies (Levine, Kim, & Hamel, 2010).

Regarding the amount of detail reported, truth tellers often provide more details than
liars (Amado et al., 2016), influenced by the different strategies used by truth tellers and liars
in an interview (Hartwig et al., 2007). Truth tellers typically employ a forthcoming strategy
to achieve the goal of being believed (Gran Hag & Hartwig, 2008). They may hold a belief in
a just world (Lerner, 1980) which suggests that people believe that the world is fair and that
someone receives what s/he deserves. Therefore, truth tellers may believe that if they are forthcoming, they will be believed (Feather, 1999). In addition, according to the illusion of transparency (Gilovich, Savitsky, & Medvec, 1998; Savitsky & Gilovich, 2003), people believe that their true feelings and intentions will be apparent to others. Therefore, when being forthcoming truth tellers may believe that their honesty will be evident to the interviewer. Liars also share the goal of being believed during the interview. However, they do not take their credibility for granted. Therefore, they employ counter-interrogation strategies to achieve their goal (Hartwig et al., 2007). Liars tend to experience an information-management dilemma (Granhag & Hartwig, 2008). Feigning memory loss or providing only ‘I don’t know’ answers will not give leads to investigators but may hamper their credibility because it results in statements that lack detail. Therefore, liars need to provide details to make a convincing impression, but they need to withhold from reporting some details to avoid the risk of getting caught.

Counter-interrogation strategies used by liars can be understood through the lens of self-regulation theory (Carver & Sheier, 2002). Psychology of self-regulation refers to a conscious personal management of processes (thoughts, behaviours, and feelings) aimed at controlling and directing the person towards desired goals or away from undesirable outcomes (Fiske & Taylor, 2008). The desired goal for liars is to convince the interviewer that the statement is true, and undesired outcome for them is to get caught in lying. It can be argued that under some circumstances truth tellers can also experience an information-management dilemma during the interview. For example, an innocent person suspected of rape can avoid mentioning that s/he was indeed flirting, because such information could raise suspicion. However, research with both laypeople and individuals with a criminal history have shown that truth tellers were more likely to use forthcoming strategies, and liars more commonly used counter-interrogation strategies (Granhag & Hartwig, 2008).
1.4.2 Interviewing with CCA to detect deceit

Probably the two main interviewing approaches to elicit differences between truth
tellers and liars identified in the literature are: The Strategic Use of Evidence (SUE; Granhag
& Hartwig, 2015) and CCA (Vrij, 2018). The SUE interviewing technique refers to
interviews with suspects and is based on the idea of asking questions related to the evidence
without making the suspect aware that the investigator possesses this evidence. In this thesis
the focus will be on CCA because using mnemonics is related to this verbal lie detection
interviewing approach.

The CCA comprises three interviewing techniques: Imposing cognitive load, asking
unexpected questions, and encouraging interviewees to say more (Vrij, 2018). Imposing
cognitive load refers to situations where investigators can exploit the different mental states
of truth tellers and liars by making interview settings cognitively more challenging. For
example, interviewees can be asked to engage in a concurrent, second, task when reporting
the event (e.g., telling what happened while gripping an object, Visu-Petra, Varga, Miclea, &
Visu-Petra, 2013). Mental resources of liars are more depleted than truth tellers. Therefore,
they tend to be less able to cope with additional requests than truth tellers (Debey,
Verschuere, & Crombez, 2012). Another technique, asking unexpected questions, is based on
the assumption that liars prepare themselves to answer the questions they expect to be asked
(Hartwig et al., 2007). Therefore, liars experience more difficulties when responding to
unexpected than to expected questions or tasks, whereas truth tellers answer either with
similar ease because they rely on their real experiences (Lancaster, Vrij, Hope, & Waller,
2013). Finally, the encouraging interviewees to say more technique is related to creating a
setting in which interviewees are encouraged to provide more details. Truth tellers then tend
to report more details than liars, because liars are not inclined to say much out of fear that the
additional details they report will give leads to investigators and hence give their lies away (Granhaug & Hartwig, 2008; Nahari, Vrij, & Fisher, 2014).

Using mnemonics is part of the CCA approach to encouraging interviewees to say more. A recent meta-analysis examined the effectiveness of the CCA approach (Vrij et al., 2017) and showed that encouraging interviewees to say more techniques produced better discrimination between truth tellers and liars than standard interviewing approaches.

1.4.3 Verbal content of the statements

To examine differences between truth tellers and liars using the CCA approach, the verbal content in their reports is analysed. Statements provided by interviewees contain different types of detail. Two most widely used and scientifically examined statement analysis tools are criteria-based content analysis (CBCA; Steller & Köhnken, 1989) and reality monitoring (RM; Johnson & Raye, 1981). CBCA is based on the hypothesis, originally stated by German psychologist Udo Undeutsch, that a statement derived from memory of an actual experience differs in content and quality from a statement based on invention or fantasy, known as the Undeutsch hypothesis (Undeutsch, 1967). The tool consists of 19 criteria (e.g., logical structure, contextual embeddings, quantity of details, and descriptions of interactions), and trained evaluators judge the presence or absence of these criteria (Vrij, 2008, 2015). The core idea of CBCA is that the presence of each criterion strengthens the hypothesis that the statement is based on genuine personal experience. Although the tool was originally designed to assess children’s credibility when they may be victims of sexual abuse and is used as evidence in court, for example, in Germany, it now also has applications for adult witnesses or suspects (Vrij, 2008).

Another tool, RM, is the detail scoring method typically used in deception studies (Vrij, 2015). The core idea of RM is that memories of real experiences differ from memories based
on imagination (Johnson & Raye, 1981). Genuine experiences are obtained through perceptual processes and, therefore, are likely to contain sensory (e.g., visual, auditory, or olfactory), contextual (e.g., spatial, temporal), and affective (details about people’s feelings) information. Such memories are usually clear and vivid. In contrast, recollections of imagined events originate from an internal source, and are therefore, likely to involve cognitive operations, such as thoughts and reasonings (e.g., ‘I must have stayed at home that day as I was waiting for a parcel delivery’). Memories of imagined events are typically vaguer and less concrete than memories of real events (Vrij, 2008, 2015).

RM deception researchers argued that truth tellers’ reports are based on real memories and liars’ reports are based on imagined memories. Experimental research using the RM approach has shown differences between truth tellers and liars in terms of reporting RM criteria (Masip et al., 2005; Vrij, 2008). Specifically, it was found that truth tellers reported more perceptual, spatial, and temporal information than liars. However, the RM approach has an important limitation. The main assumption of this concept is related to differentiation between real experiences and imagined events, yet it is known that not all lies are complete fabrications which a person did not at some time experience (Vrij, 2008, 2015). A liar can describe an actually experienced event by just changing and/or omitting some crucial details. For example, a suspect can tell the truth about spending the night in a bar, but avoid mentioning his/her involvement in the fight there. Or someone can report an event (e.g. going to a restaurant) completely and truthfully but lie about when the visit to the restaurant occurred. Research has shown that liars tend to include truthful parts in their stories (Hartwig et al., 2007; Harvey, Vrij, Leal, Hope, & Mann, 2017) and the more truthful a deceptive statement is, the more difficult it can be for RM to distinguish such a deceptive statement from an entirely truthful statement.
In studies examining the CCA approach, RM details have often been analysed (Lancaster et al., 2013; Porter et al., 2018; Vrij et al., 2009). Four RM types of detail were used in this thesis to examine reports from truth tellers and liars: *Visual details*, specific items/description of items seen by the interviewee (e.g., ‘table’, ‘phone’, ‘wallet’); *spatial details*, information about locations or spatial arrangements of people or objects (e.g., ‘to the left’, ‘behind’, ‘upstairs’); *temporal details*, refer to the sequence of activities, their duration, or information when something happened (e.g., ‘in the beginning’, ‘for five minutes’, ‘it was late evening’); and *action details*, information about the actions carried out by people in the event (‘picked up’, ‘walked’, ‘talking to her’). Other types of RM detail were not examined because they were absent from the stimulus material (e.g., auditory, olfactory, and tactile details) used in the studies of this thesis, or found to be unreliable for distinguishing truthful and deceptive statements in previous deception research (e.g., cognitive operations; Masip et al., 2005).

### 1.5 Detecting deception with mnemonic techniques

Originally, specific mnemonic techniques were created to improve investigative interviewing with cooperative witnesses (Fisher & Geiselman, 1992). Research over the last few decades has shown that compared to standard interview approaches, the Cognitive Interview (CI) - which consists of mnemonic techniques - increased the amount of correct information without the cost of increased error rate from the interviewees (Köhnken, Milne, Memon, & Bull, 1999; Memon, Meissner, & Fraser, 2010). Given these documented benefits of using memory-enhancing techniques with truthful individuals, it can be hypothesised that these techniques could be effective in detecting deception. The rationale behind this assumption is that using mnemonics should help truth tellers to report more information,
whereas it should not result in the same amount of additional information from liars because they typically face information-management issues during interviews, as described above.

Previous findings have shown that the use of mnemonics differentiate between truthful and deceptive statements. In one study, truth tellers and liars were interviewed with the CI, or with a standard interview protocol that did not contain mnemonics (Hernández & Alonso-Quecuty, 1997). Truth tellers reported more spatial, temporal, and sensory details than liars, particularly when the CI was used. In another study, results suggested that the CI was more efficient than a standard interview in discriminating between truth tellers and liars when examining actions and objects details (Bembibre & Higuera, 2011). In a recent study using three different samples from Russia, USA, and Republic of Korea, the instruction to sketch while narrating the story produced more new details from truth tellers than liars, whereas no difference was found between veracity groups in reporting details when no instruction to sketch was given (Vrij et al., 2018). Some other studies have demonstrated the effectiveness of the CI to detect deception, although they did not include comparison (control) groups. For example, in a study where interviewees were questioned with the CI one week after a mock theft event, truthful accounts contained more details than deceptive accounts (Colwell, Hiscock-Anisman, Memon, Taylor, & Prewett, 2007). In another study, when context reinstatement and the report everything mnemonics were used, temporal and auditory details were more frequent in truthful than in deceptive accounts (Memon, Fraser, Colwell, Odinot, & Mastroberardino, 2010). Recently, a version of the CI for use with suspects adapted by Geiselman (2012) was examined (Logue, Book, Frosina, Huizinga, & Amos, 2015). This version contained the sketch mnemonic. Truth tellers reported more visual, spatial, temporal, auditory, cognitive, and affective details than liars. In summary, previous findings suggest that mnemonics can aid in effective discrimination between truthful and deceptive accounts. As this thesis focuses on deception detection using mnemonic
techniques in repeated interviewing, it is first important to discuss how the quality of immediate interviewing affects the memories of truth tellers in delayed interviews.

1.6 Memory and repeated interviewing: The role of initial interviewee’s account on delayed performance

Immediate interviewing is relevant because items of information are more accessible in interviewees’ memory shortly after an event than over longer periods of time. From early memory research it is known that learned information tends to be forgotten over time when there are no attempts to retain it (Ebbinghaus, 1885/1913; Lawson & London, 2015; Turtle & Yuille, 1994). When the information has not been ‘used’ (retrieved), memory traces weaken and the amount of recalled information can systematically decrease after a time delay (Pansky et al., 2005; Rubin & Wenzel, 1996). Different studies have shown a significant decrease of recalled information in the absence of retrieval practice (Evans & Fisher, 2011; Odinot & Wolters, 2006; Schacter, 1999). Retrieval practice, or testing effect, refers to an act of recalling to mind a previously experienced event or learned information (Roediger & Butler, 2011). Research has shown that memory testing soon after an event may have beneficial effects of ‘inoculating’ witness memory against forgetting (Bornstein et al., 1998; Gabbert, Hope, & Fisher, 2009; Pansky & Nemets, 2012).

The quality of immediate recall can also influence reporting of information later on. The spreading activation theory of memory suggests that memory functions as a network system with associative links (Anderson, 1983). The activation of specific items during retrieval strengthens memory traces of these items. Moreover, memories of associated but not practiced pieces of information are also strengthened. An immediate, high-quality, recall enhances subsequent recall attempts from episodic memory because it strengthens activation
levels of items and the associations between them (Anderson, 1983). Hence, the more information is represented at the immediate attempt, the more it is accessible at the repeated retrieval attempts. Conversely, incomplete initial recall attempts can impair later recall. Specifically, if an initial account of the interviewee contains little detail, the quantity of information may be impeded in his/her delayed account because of reduced accessibility to information that was not recalled initially (Hope et al., 2014; Levy & Anderson, 2002). Thus, if initial accounts are not as complete as possible, there is a risk of substantial loss of information when the event is reported at later occasions (Macleod, 2002). In interviewing settings, it can result in an interviewee’s impaired memory of the important information for a case (Shaw, Bjork, & Handal, 1995).

Previous research has demonstrated that appropriate immediate interviewing can help to elicit more information and produce fewer errors from the interviewee than immediate questioning eliciting less complete accounts. In a study with police call centre handlers it was found that the report everything instruction elicited significantly more information from interviewees than both the ‘five Wh- questioning strategy’ and a control condition (in which they were simply asked to provide brief details about the incident), with no differences in accuracy rates of reported information across conditions (Pescod, Wilcock, & Milne, 2013). Previous studies also found that interview formats that elicit high-quality (i.e. complete and accurate) initial accounts enhanced the amount and accuracy of reported information after a delay. For example, in one experiment participants viewed a film about an attempted car break-in (Gabbert et al., 2009). Half of the participants provided initial reports with the Self-Administered Interview (SAI) tool comprising five different sections of instructions (CR, report everything, person descriptions, sketch, and other information) that were designed to facilitate the reporting of information. The other half of witnesses was not interviewed immediately. When all participants were requested to complete a free recall test after a one
week delay, the SAI group reported more information than the witnesses without an initial interview. However, a limitation of this study was that it did not contain any other immediate interview format as a comparison to the SAI. A follow-up study addressed this issue (Hope et al., 2014). Mock witnesses either initially provided an account with the SAI, or made a free recall, or did not report information. All participants were then interviewed with the CI after one week. The initial accounts of participants were more complete using the SAI than the free recall. Also, the SAI group provided more detailed accounts after the delay than participants in the other two conditions. Overall, scientific evidence has shown that the immediate and high-quality interviewing can be beneficial for the delayed interviewees’ memory performance. The next section will overview the role of immediate interviewing on delayed reporting of information with regard to deception detection.

1.7 Detecting deception in repeated delayed interviewing

Lie detection in the context of repeated interviews with respect to the cues typically examined in verbal deception research will be discussed: Amount of details reported in a statement, and between-statement consistency (Amado et al., 2016; Vrij et al., 2017; Vredeveldt et al., 2014).

1.7.1 Amount of reported details in the accounts

Only a few deception studies examined the amount of details in repeated statements that were reported over different periods of time. In one study, participants witnessed a staged robbery (Granhag & Strömwall, 2002). They were interviewed three times about that event, the same day, after four days, and after seven days. The results showed no differences in the number of visual, temporal, auditory, and location details reported by liars and truth-tellers in
any of the three interviewing sessions. In another study, pairs of truth tellers and pairs of liars were tasked to have lunch together, or create a story of having had lunch together (Granhag, Strömwall, & Johnson, 2003). They were interviewed immediately after the alleged lunch and again after a one-week delay. Truthful statements contained more information than deceptive statements during both interviews. A limitation of those studies was that the participants were not tasked to do their best to be believable during the interviews, a condition necessary to mirror real life situations. Research has shown that truthful responses differ from deceptive responses more when interviewees are motivated to be believed (DePaulo et al., 2003). In a more recent study in which this motivation requirement was met, participants were asked to either carry out non-criminal activities (truth tellers), or commit a mock theft which they then should deny during the interview (liars) (Nahari, 2018). In a condition where suspects were interviewed repeatedly, truth tellers reported more perceptual and contextual details than liars, both immediately and after a two-week delay. In general, given the findings of these few studies it is difficult to make any conclusions about the role of immediate interviewing to detect deception after a delay.

Although the effects of immediate interviewing on deception detection in subsequent interviewing are unknown, there is research evidence about the negative effects of delay (without immediate testing) to differentiate between truth tellers and liars. In one study, pairs of participants were asked either to have lunch together (truth tellers), or commit a mock theft and then create an alibi of having had lunch together (liars) (Vrij et al., 2009). Participants were interviewed either immediately, or after a one-week delay. Results showed that truthful pairs reported more details than deceptive pairs in the immediate interview, however, this difference was no longer significant in the delayed interview. Similarly, in a recent study, in which participants carried out a mock intelligence operation, it was found that truth tellers reported more details than liars when they were interviewed immediately, but there was no.
difference in the amount of details after a three-week delay (Harvey et al., 2017). In Nahari (2018), it was found that truth tellers demonstrated larger variability than liars in the amount of details they reported across different delay periods. Specifically, truth tellers provided more information when they were interviewed immediately compared to when they were interviewed two weeks after the event. However, liars reported a similar amount of details, regardless of the retention interval between the incident and the interview. Moreover, some studies have shown that delay can negatively affect the efficacy of credibility assessment tools. For example, when examining the accuracy of discriminating truth tellers from liars using physiological electrodermal measure and symptom validity tests (Nahari & Ben-Shakhar, 2011) it was found that the tools were more efficient in detecting truth tellers and liars for reporting peripheral (unrelated to the crime) details, when participants were tested immediately than after a one-week delay. In another study, the verbal quality of statements provided by truth tellers and liars was assessed using two credibility tools, RM and CBCA (McDougall & Bull, 2015). Truthful statements achieved higher RM and CBCA scores than deceptive statements, but only when interviews were conducted shortly after the mock crime event. The RM and CBCA scores did not differ across veracity conditions when interviewees were questioned after 7-10 days.

Overall, previous research suggests that a time delay between an event and interview may hamper discrimination between truthful and deceptive accounts based on the amount of provided details. A possible explanation for this is that delay affects memories of truth tellers, i.e., they remember less information over time, but that fabricated accounts do not depend to the same extent on the passage of time after the event, because liars have the opportunity to fabricate information. A study of Nahari (2018) demonstrated that liars were less dependent on time delay than truth tellers. Specifically, when liars incorporate truthful elements in their stories, they could also experience a decline in truthful details after the delay. However, liars
fixed the problem by adding false (unverifiable) details to their stories to make an honest impression (Nahari, 2018). Liars’ tendency to add details could be explained through ‘the stability bias’. Liars typically experience difficulties in understanding the real nature of memory, including the effects of a time delay (Harvey et al., 2017). It is more important for liars to bear in mind a sufficient amount of detail in their story as an important factor to be believed by the interviewer (Hartwig et al., 2007; Nahari et al., 2014). Therefore, they may be unwilling to reduce the amount of detail after the delay below a threshold perceived as necessary to appear genuine. A solution is to add fabricated details.

If passage of time does not affect the quantity of details liars report, it is worth exploring ways to facilitate truth tellers reporting more information and thus maintaining richness of detail as a diagnostic credibility cue even after a delay. In this thesis whether using mnemonic techniques in the immediate interview can show this potential in detecting deception after a delay was investigated.

1.7.2 Between-statement consistency

When an interviewee is questioned several times about one incident, the question of consistency between his/her statements is often raised by legal professionals (de Keijser, Malsch, Kranendonk, & de Gruijter, 2011; Granhag & Strömwall, 2001; Krix, Sauerland, Lorei, & Rispens, 2015). Practitioners tend to believe that consistency is an indicator of truthfulness, and inconsistency is a sign of lying (Bogaard, Meijer, Vrij, & Merckelbach, 2016; de Keijser et al., 2011). However, research has revealed that truth tellers can be equally or even less consistent than liars (Vredeveldt et al., 2014). For example, in an experiment with pairs of suspects, no differences were found between truth tellers and liars in terms of the amount of reported repetitions and omissions, however, truth tellers reported more reminiscences than liars (Granhag et al., 2003). Other research has shown that truth tellers
were equally or less consistent than liars when interviewees were children (Strömwall & Granhag, 2005); when the interviewee was or was not very familiar with the environment of the event (Deeb et al., 2018); or when suspects were interviewed about future intentions (Granhag et al., 2016).

A theoretical rationale to account for liars’ tendency to be consistent between their statements was proposed by Granhag and Strömwall (1999): the repeat vs. reconstruct hypothesis. According to this hypothesis, liars believe that being consistent is important in order to make an honest impression. Liars are therefore keen to repeat their original story when they are interviewed again. In contrast, truth tellers are less concerned with what they reported in previous interviews. They try to remember the event in question again when asked about it and, due to the reconstructive nature of human memory, add, omit or alter details in the repeated interview (Baddeley, Eysenck, Anderson & Anderson, 2009; Loftus, 2003). Specifically, repeated retrieval attempts may lead to the recall of previously inaccessible memories, although some previously remembered information may also be likely to be unreported. In sum, the repeat vs. reconstruct hypothesis suggests that the ‘repeat’ strategy used by liars during interviews should promote consistencies, and the ‘reconstructive’ nature of truth tellers’ reporting of information should promote various inconsistencies between their responses (Odinot & Wolters, 2006; Roediger, McDermott, & Goff, 1997; Turtle & Yuille, 1994).

Liars can be less consistent than truth tellers when specific interviewing techniques are used (Vredeveldt et al., 2014), often related to imposing cognitive load on the interviewee (Vrij, 2008, 2015). For example, research suggests that liars become less consistent than truth tellers when the question format changes between interviews (Deeb et al., 2017; Leins, Fisher, & Vrij, 2012). In one experiment, truth tellers were requested to enter a room and perform a few tasks, whereas liars were asked to pretend and convince the interviewer that
they performed the same tasks as the truth tellers (Leins et al., 2012). Participants were interviewed twice, and were asked to report information either verbally or through sketching the scene. Liars were less consistent than truth tellers between the interviews, and this difference was larger when the modalities from the first to the second interview changed (verbal-sketch, or vice versa). In a recent study, participants were interviewed twice about two mock intelligence events (Deeb et al., 2017). Truth tellers were asked to describe both events truthfully, whereas liars were asked to tell the truth about one event but to lie about the other event. Three different interview formats were used in the study: a request to provide a free recall, questions about one event at a time, or questions about the two events in random order. Participants were interviewed repeatedly either using the same (provide free recall twice), or different interview formats (first free recall, then either sequential or random order questions). Liars were less consistent (i.e., reported fewer repetitions) than truth tellers, when interviews changed from free recall to randomly ordered questions about the two events. These findings can be explained in terms of cognitive flexibility (Leins et al., 2012). As truth tellers’ statements are based on real memories which are typically multi-dimensional, their ability to report details consistently should not be constrained by the interviewing format. However, liars’ cognitive flexibility should be affected by the interview format. Specifically, when questioning formats are the same across interviews, liars should not experience difficulties in maintaining their ‘repeat’ strategy in order to be consistent. However, when the modalities differ between interviews, liars should have more difficulty to use this strategy, thus, constraining consistency between the statements. In sum, previous research suggests that truth tellers can be equally or less consistent than liars when the interviewer employs the same questions/instructions across the interviews. However, liars may experience more difficulties to be as consistent as truth tellers, when questioning is not identical across the interviews.
In this thesis, not only the effects of mnemonic techniques on eliciting differences between truth tellers’ and liars’ responses were of interest, but also the ability of observers to detect these differences. The following section discusses the accuracy of human judgements about truths and lies.

1.8 Accuracy in human veracity judgements

In real life practitioners make credibility judgements based on the statement(s) provided by the interviewee. If statistical analyses indicate that using specific interviewing techniques are effective in distinguishing truth tellers from liars, it does not necessarily mean that these differences will be detected by an interviewer with the same success in a particular interviewee. Researchers have shown that both laypeople and professionals are typically poor at detecting lies, with accuracy rates not much higher than chance level (Bond & DePaulo, 2006). One reason for this low accuracy is that most cues to deception are weak, and people tend to make veracity judgements based on these unreliable cues (Global Deception Research Team, 2006; Hartwig & Bond, 2011; Vrij, 2008).

Detection of deception can improve when people rely on the correct verbal cues. In one study it was found that police officers’ accuracy rates were positively associated with their decisions having been based on content-related cues (Mann, Vrij, & Bull, 2004). Another study showed that undergraduate students and police officers with better insight into verbal cues to deception increased their accuracy in identifying truthful statements (Bogaard & Meijer, 2018). A recent meta-analysis showed that training into cues to deception improved lie detection accuracy, but only if the training was based on verbal content cues (Hauch, Sporer, Michael, & Meissner, 2016). Finally, in a study where some college students and police officers were coached to look at consistencies or evasive answers in repeated
statements (Masip et al., 2018), it was found that coached participants performed better in identifying truthful and deceptive statements than uninstructed individuals.

To summarise the introduction of this thesis, scientific evidence has demonstrated that specific interviewing techniques (e.g., mnemonics) can be effective in verbal lie detection. However, such benefits are typically achieved when an interview is conducted shortly after the event in question. A time delay between an incident and the first interview can impair differentiation between truth tellers and liars with respect to the amount of reported information. Not much is known about how mnemonic techniques used in the immediate interview can affect the delayed statements of truth tellers and liars. In addition, it is important to extend the knowledge about between-statement (in)consistency of truth tellers and liars, and observers’ lie detection accuracy in the context of using mnemonics in repeated interviewing.

1.9 General and specific aims

The thesis has four general aims: i) to examine how mnemonic techniques used in the immediate interview affected immediate and delayed statements of truth tellers and liars; ii) to assess how the amount of details reported changed between immediate and delayed interviews within truthful and deceptive statements; iii) to examine the consistency of truth tellers’ and liars’ statements across interviews; and iv) to examine the extent to which observers can distinguish truths from lies in the repeated statements, when applying mnemonic techniques in the immediate interview.
Table 1.1

Overview of the studies of this thesis

<table>
<thead>
<tr>
<th>Study No.</th>
<th>N</th>
<th>Location</th>
<th>Independent variables</th>
<th>Dependent variables</th>
</tr>
</thead>
</table>
| I         | 143| University of Portsmouth, United Kingdom | Between-subjects factors:  
Veracity (Truthful vs. Deceptive)  
Immediate Mnemonic (Context Reinstatement vs. Sketch vs. Event-line) | Within-subjects factor:  
Time of Interview (Immediate vs. Delayed)  
Types of detail: Visual, spatial, temporal, and action details |
| II        | 49 | University of Portsmouth, United Kingdom | Between-subjects factor:  
Veracity (Truthful vs. Deceptive) | Within-subjects factor:  
Time of Interview (Immediate vs. Delayed)  
Between-statement consistency:  
Reminiscences, repetitions, and omissions |
| III       | 80 | University of Gothenburg, Sweden | Between-subjects factors:  
Veracity (Truthful vs. Deceptive)  
Immediate interview (Report Everything vs. Spatial Questions) | Within-subjects factor:  
Time of Interview (Immediate vs. Delayed)  
Veracity judgements  
Self-reported cues to truth/deceit |
| IV        | 96 | University of Portsmouth, United Kingdom | Between-subjects factor:  
Instruction (Informed group vs. Uninformed group) | Veracity judgements  
Self-reported cues to truth/deceit |
Table 1.2

*Instructions of mnemonic techniques used in the thesis*

<table>
<thead>
<tr>
<th>Interview instruction</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report everything:</td>
<td></td>
</tr>
<tr>
<td>“Report all details that you can remember about the break-in, including descriptions of objects and locations, the sequence of actions, and information about any people that were involved, including other witnesses or passers-by. Do not guess about details that you cannot remember.”</td>
<td>Study I, III</td>
</tr>
<tr>
<td>CR:</td>
<td></td>
</tr>
<tr>
<td>“I want you to take me back to the very start of that event, to the moment you entered the community centre. Take a few moments to picture in your mind where you were and what you saw at the time. Think about who you were with and what you could see during the event, including descriptions of objects and locations, and the sequence of actions. Give yourself plenty of time to concentrate, and visualise what happened during that event. It may help to shut your eyes while you remember the event. Now tell me everything you remember.”</td>
<td>Study I</td>
</tr>
<tr>
<td>Sketch:</td>
<td></td>
</tr>
<tr>
<td>“I will ask you to make a sketch of the community centre you have broken into. Making a sketch of the scene may help you to remember details – and provide further information about the community centre. Please use as much space as you need to sketch it as you remember it. You should include as many details as possible, including as much information as you can about where different objects were in relation to other objects. You can use labels and notes within your sketch to indicate features of the scene, or to indicate if you are not certain of something. This is not a test of your drawing ability – we are only interested in the layout of the apartment, that is, what you saw, and where. Sketch it in silence. After participant made the sketch, the following instruction was given: “I now want you to describe your sketch to me in so much detail that I would be able to make your sketch based on what you said. Thus, use words rather than just pointing at your sketch.”</td>
<td>Study I, II</td>
</tr>
<tr>
<td>Event-line:</td>
<td></td>
</tr>
<tr>
<td>“Now we are going to ask you to complete an ‘Event-line’. The purpose of the event-line is to help you organise your memory of the break-in. Importantly, it should help you put your account of the incident in the right order. This will be an initial account of the period of time you spent in the building, from the beginning until the end. You should use this opportunity to recall and report what activities you engaged in and when these took place along the event-line. Write down what happened in the empty space below the event-line and then put an arrow on the event-line indicating the time of the activity. Complete the event-line in silence. After participant completed the event-line, the following instruction was given: “I want you to describe your event-line to me in so much detail that I would be able to make your event-line based on what you said.”</td>
<td>Study I</td>
</tr>
</tbody>
</table>
In the experiments (Studies I, II, and III) conducted for this thesis participants were interviewed twice: immediately after the event and after a two-week delay. Different mnemonic techniques were employed in the immediate interviews. Regarding the specific aims, Study I investigated how three mnemonic techniques (context reinstatement, sketch, or event-line) employed in an interview conducted immediately after an event affected truth tellers’ and liars’ responses when they were interviewed again after a two-week delay.

The aim of Study II was to assess how the sketch mnemonic technique affected truthful and deceptive immediate and delayed statements. The aim of Study III was to examine how two different types of interviewing (report everything mnemonic vs. spatial open-ended questions) used in an interview conducted shortly after an event affected truth tellers’ and liars’ responses when they were interviewed again after a two-week delay. In Studies I, II, and III, the number of visual, spatial, temporal and action details, and the number of consistency characteristics (reminiscences, repetitions, and omissions; Granhag & Strömwall, 2002; Granhag et al., 2016; Deeb et al., 2017) were analysed in the statements of truth tellers and liars. Finally, the aim of Study IV was to examine whether the differences between truth tellers and liars found in Study I could be accurately detected by participants who read the statements of that study. Table 1.1 shows an overview of studies conducted in the thesis. In Table 1.2 instructions of each mnemonic technique given to participants are presented.
Chapter 2: Facilitating memory-based lie detection in immediate and delayed interviewing: The role of mnemonics (Study I)

Published as:
Abstract

It was experimentally investigated how different mnemonic techniques employed in an interview conducted immediately after an event affected truth tellers’ and liars’ responses when they were interviewed again after a two-week delay. How verbal accounts changed over time within truth tellers and liars were also compared, and how consistent both groups were. Participants (n = 143) were shown a mock intelligence operation video and instructed either to tell the truth or lie about its contents in two interviews, one of which was immediately after watching the video and the other after a two-week delay. In the immediate interview they were asked to provide a free recall and then asked to provide further information via one of three mnemonics: Context Reinstatement, Sketch, or Event-line. In the delayed interview they were asked to provide only a free recall. Truth tellers reported more visual, spatial, temporal, and action details than liars both immediately and after a delay. Truth tellers and liars experienced a decline in reporting some details after a delay, and this decline was affected by the mnemonic used. Truth tellers and liars were equally consistent between their immediate and delayed statements.
2.1 Introduction

Deception researchers have started to address memory-related factors affecting the statements of both truth tellers and liars in repeated and delayed statements (McDougall & Bull, 2015; Vrij et al., 2009; Harvey et al., 2017). In interviewing contexts, memory-related issues are important for two reasons: First, complete and accurate statements provided by cooperative witnesses or suspects are one of the main goals of investigative interviews (Geiselman et al., 1984; Kebbel & Milne, 1998; Pansky & Nemets, 2012). Memory retrieval for original information becomes more difficult over time, which can result in less complete statements compared to accounts reported after a short retention interval. A decrease in forensically relevant reported information may negatively affect a criminal investigation. Second, a vaguer content can raise doubts about someone’s credibility. Previous studies with police officers have shown that the amount of information provided is an important cue for them to decide whether or not an interviewee is credible (Akehurst, Köhnken, Vrij, & Bull, 1996; Strömwall & Granhag, 2003).

One factor that could facilitate retrieval of information even after long retention intervals is the use of memory-enhancing techniques (or ‘mnemonics’) (Fisher & Geiselman, 1992). Using mnemonics is valuable in real life because truthful interviewees can provide a lot of details valuable for criminal investigations, including descriptions of people, times of the criminal activities, locations of various crime related objects, etc. It is also important to understand whether deceptive interviewees tend to respond differently to mnemonics after different retention intervals. How different mnemonics affected immediate reports by truth tellers and liars and how these mnemonics affected their responses when they were interviewed again after a two-week delay was examined in this study.
2.1.1 Mnemonics and deception

Research has shown the advantage of using mnemonics over standard question-answer interviewing techniques in terms of eliciting more complete statements, without the cost of an inflated amount of inaccurate information (Davis, McMahon & Greenwood, 2005; Fisher, Geiselman, & Amador, 1989; Memon, Meissner, & Fraser, 2010).

Different types of mnemonic techniques have been adapted for use in investigative interviewing, three of which are introduced in this study. Context reinstatement (CR) requires witnesses to mentally place themselves back in the experienced event (Fisher & Geiselman, 1992). Studies have shown memory improvement in recalling details when using this mnemonic in both children and adults (Priestley, Roberts, & Pipe, 1999; Wong & Read, 2011). Another technique, making a Sketch of the crime scene, has also resulted in a more complete account of an event compared to standard questioning procedures (Dando, Wilcock, Behnkle, & Milne, 2011; Dando et al., 2009). Finally, the Event-line mnemonic technique, is based on the Timeline interviewing format developed by Hope et al. (2013), which is related to reproducing temporal context and sequence of actions in an event. The Timeline facilitated more correct information than a free recall both immediately after an event and after a two-week delay (Hope et al., 2013). In this study, CR was positioned as a generic mnemonic which is known as an effective memory-enhancing technique (Dando et al., 2009; Emmett, Clifford, & Gwyer, 2003; Fisher & Geiselman, 1992). The effects of more specialised mnemonics (sketch and event-line) that target specific types of information (spatial or temporal) and contrast them with performance on a generic CR was also sought to examine.

Previous findings suggest that the use of mnemonics can aid in discriminating between truthful and deceptive statements (Bembibre & Higueras, 2011; Mac Giolla et al., 2017; Vrij et al., 2010), because truth tellers benefit more from such memory enhancement techniques than liars. Liars may lack the imagination to report as many (plausible) details as
truth tellers, or they may be unwilling to do so out of fear that these additional details give checkable leads to investigators (Vrij et al., 2017).

Regarding real life interviewing settings, the application of mnemonics can be valuable because they do not require many resources (e.g., in contrast to polygraph machines), and are easy to implement and analyse (Mac Giolla et al., 2017; Vrij et al., 2010). Thus, these techniques can be useful for practitioners to make inferences about the credibility of interviewees. As yet it is unknown how different mnemonics affect not only immediate, but also delayed statements reported by truth tellers and liars.

In this study, the effects of three mnemonics on truth tellers’ and liars’ immediate statements and repeated statements after a two-week delay were examined: CR mnemonic, spatial mnemonic (using sketch), and temporal mnemonic (using event-line). In the immediate interview, truth tellers and liars were first invited in a free recall to report everything they could remember about the event. After the free recall, a mnemonic was introduced and the interviewees were again invited to report all they could remember. Truth tellers and liars were then interviewed again after a two-week delay (free recall phase only).

2.1.2 Hypotheses

In this study, the interest was in the differences between the report content of truth tellers and liars in immediate and delayed interviews. As a result of retrieval practice in the CR condition, it was expected that neither truth tellers nor liars would show a memory decline in reporting detail after a delay, and that truth tellers would report even more visual, spatial, temporal, and action details than liars after a delay in the CR condition (Hypothesis 1). In the Sketch condition it was predicted that truth tellers would report more visual and spatial details than liars after a delay as a result of practising these details in the sketch. It was also expected that truth tellers, but not liars, would show a memory decline in temporal and
action details after a delay, as these details would be less practiced in the sketch (Hypothesis 2). In the Event-line condition, it was predicted that truth tellers would report more temporal and action details than liars after a delay as a result of practising these details in the event-line. Truth tellers, but not liars, would show a memory decline in visual and spatial details after a delay, as these details would be less practiced in the event-line (Hypothesis 3). Finally, how consistent truth tellers and liars would be in immediate and delayed interviews was also of interest. In line with the above reasoning, it was predicted that truth tellers would produce more reminiscences and omissions than liars between immediate and delay interviews (Hypothesis 4).

The immediate interview included two parts, a free recall phase and a mnemonic phase, which was introduced due to its operational relevance. Specifically, in real life situations it is arguably more typical to start with a general open-ended request and then ask for more specific information, than to start by asking more specific questions then ask a general open-ended request. Furthermore, the recent investigative interviewing guidelines suggest using free recall first and follow with mnemonic techniques (Milne & Bull, 1999; Milne, Shaw, & Bull, 2007). In the analyses of the immediate and delayed reports, comparisons were made only between the free recall phases of the immediate and delayed interviews (the delayed interview only included a free recall phase). The information provided in the mnemonic phase of the immediate interview was not considered for two reasons: First, comparisons between immediate and delayed statements within conditions would be difficult in terms of the amount of details. In all experimental conditions, immediate statements would obviously be richer in detail because immediate interviews contain two phases whereas delayed statements only contain one. Second, different mnemonics could elicit different amounts of information due to their specifics. Therefore, it would also make comparisons of immediate and delayed reports complicated.
Although hypotheses related to participants’ performance during the mnemonic part of the immediate interview were not specifically formulated, it was considered important to report the outcomes of this phase of the interview, as it gives further insight into how truth tellers and liars respond to mnemonics.

2.2 Method

2.2.1 Participants

A total of 143 participants took part in the study. A post hoc power analysis showed that this study had enough power (Cohen, 1992) of 0.99 to obtain medium effect sizes. The mean age of participants was 25.57 years ($SD = 12.55$) and 35.7% were male. In the sample, 80.4% were undergraduate and postgraduate students, and 18.6% were members of the general public. Participants were recruited via posters, flyers, online participant pool system, and online advertisements on the University’s staff portals. As the experiment focused on the verbal content of the statements, native English speakers were prioritised to take part. The majority of participants (93.7%) were English native speakers; the remaining participants were fluent in English. Participants were awarded two course credits or £10 for taking part in the study. In addition, all participants were entered into a draw to win a single prize worth £150 on completion of the experiment. The study was approved by the Science Faculty Ethics Committee of the University.

2.2.2 Design

A 2 (Veracity: Truthful vs deceptive) X 3 (Mnemonic type: CR vs sketch vs event-line) X 2 (Interview time: Immediate vs delayed) experimental design was used with Veracity and Mnemonic as between-subjects factors and Interview as within-subjects factor.
Participants were randomly assigned as truth tellers \((n = 70)\) and liars \((n = 73)\). Truth tellers were randomly allocated to the CR \((n = 24)\), sketch \((n = 23)\), or event-line conditions \((n = 23)\). Similarly, liars were randomly assigned to one of the three mnemonic conditions \((\text{CR, } n = 23; \text{ sketch, } n = 26; \text{ and event-line, } n = 24)\). All participants were interviewed on two occasions, immediately after the stimulus event and (approximately) two weeks later. Not all participants were available to be interviewed again after exactly 14 days and so the delay period for the second interview varied between 8 and 21 days \((M = 14.10, SD = 1.46, \text{ Mode } = 14\) \((61.5\% \text{ of cases})\).

### 2.2.3 Materials

**Stimulus event.** Participants were instructed to watch a video about a simulated break-in. They were instructed to imagine they were taking the role of an intelligence officer working undercover with another officer. They were told their task was to break into an apartment and secure some important intelligence information. This ‘special task’ was recorded from the perspective of the person (e.g. participant) who followed the other ‘officer’ throughout the break-in. Participants were explicitly instructed that they were ‘following their colleague’ during the break-in.

The video event (lasting five minutes) shows a man entering a basement floor from the outside of the building. He then walks about ten metres through a corridor and tries to break into one of the doors at the end of the corridor. After a couple of attempts to open the door with a key, he walks into the room. The man in the video searches the room (desks, shelves, cupboards, clothes, etc.). He takes two mobile phones from a desk, jewellery (necklace and two rings) from a cupboard, a laptop from a dining table, and a driving licence, debit card, 35 euros and 20 dollars in cash from a wallet in a jacket. He then leaves the room with these items. As the man walks back along the corridor on his way out, a neighbour
opens a door, witnesses him leaving, and immediately closes the door. The man who broke in
stops and briefly looks around by the building exit. Finally, he leaves.

**Mnemonics.** Three different memory-enhancing techniques used in this study are explained below.

**CR.** In this study participants were instructed to (mentally) go back to the very start of the break-in, take a few moments to picture in their mind where they were, who they were with and what they could see during the event including the descriptions of objects, locations, and the sequence of actions. Participants were asked to give themselves plenty of time to concentrate and visualise what happened during the break-in. Also, they were requested to shut their eyes while trying to remember the event.

**Sketch.** Interviewees were asked to sketch the event and then use that drawing to describe what they had experienced. The participants made their drawing on an A3 sized blank sheet of paper. They were requested to use as much space as they needed to sketch the apartment as they remembered it. Participants were instructed to include as many details as possible about where different objects were in relation to other objects. They could also use labels and notes within their sketch to indicate the features of the scene or to indicate if they were not certain of something. After making the sketch, participants were asked to describe in as much detail as possible what they had witnessed during the break-in.

**Event-line.** In this study participants were instructed to write on an A3 sized sheet of paper with a graphical line (a grid divided into minutes) all actions from the event they could remember and to indicate on that line at what time these actions occurred. The grid was divided into six scale points (from 0 minutes to 5 minutes) because the actual break-in lasted 5 minutes and 15 seconds. The grid was located on the top of the page allowing enough space for participants to write underneath it. Participants were asked to write in the empty space and then put arrows on the event-line indicating the time of the specific activities. After
completing the event-line, participants were instructed to describe the event-line in as much detail as possible.

2.2.4 Procedure

Pre-interview phase. After watching the break-in, each participant was instructed either to tell the truth or to lie during the interview. Truth tellers and liars were given almost identical instructions. To minimise the risk of liars telling an embedded lie (for example, by describing the apartment they genuinely lived in), all interviewees were told that the apartment they broke in was a staff room of a community centre. Truth tellers were told that the break-in was successful and that they would be interviewed by a fellow agent to continue the intelligence investigation. They were asked to report truthfully during the interview 1) the interior of the staff room in the video, and 2) what they took from there. Liars where also told that the break-in was successful. However, they were told that they would be interviewed by an agent from a hostile organisation and that their task was, therefore, to mislead that agent. They were told that if the hostile agent came to know where exactly they broke in and exactly what was taken from the apartment, the entire investigation would be in jeopardy. They were instructed to tell the hostile agent a cover story that they broke into a different staff room in a different community centre. Therefore, liars were instructed to lie about 1) the interior of the apartment in the video, and 2) what they took from there. To motivate all participants to do well in the interviews they were told that they would receive two course credits or £10, and would only be entered in the draw to win £150 value prize if they were convincing during the interview. They were further told that if the interviewer thought that they did not report everything they remembered, they would only receive one course credit or £5, would be excluded from the draw, and would be asked to write down a full account of what happened in the video.
After the instructions to tell the truth or lie, participants were given unlimited time to prepare for the interview. They were given a blank sheet of paper and pen in case they needed to use whilst their preparation. However, they were not allowed to take any notes they made to the actual interview afterwards. When participants indicated that they had prepared themselves, they were given a pre-interview questionnaire in which both truth tellers and liars were requested to answer the questions truthfully. In the questionnaire participants were asked to rate on 7-point scales their preparation for the interview. They were asked to indicate how i) well they were prepared (1 = *very poor*, 7 = *very good*); and how ii) sufficient (1 = *insufficient*, 7 = *sufficient*); and iii) complete (1 = *incomplete*, 7 = *complete*) their preparation was. These three preparation items were into one variable, *Preparation quality*, since Cronbach’s alpha (.86) indicated high consistency. The pre-interview questionnaire also included questions on how iv) stressed (1 = *not at all*, 7 = *very stressed*); v) motivated (1 = *not at all*, 7 = *totally*), and vi) confident (1 = *not at all*, 7 = *totally*) the participants felt about being convincing in the upcoming interview. This pre-interview questionnaire was administered twice, both before the immediate and delayed interviews. Cronbach’s alpha for the preparation quality cluster was .86 for the delay interview.

**Interviews.** Participants were questioned by an interviewer who was blind to the aims of the study, stimulus material, and veracity conditions. At the beginning of the immediate interview, participants in all experimental conditions were given the same free recall (FR) instruction. They were asked to report everything they could remember from the break-in, including descriptions of objects and locations, the sequences of actions, and information about any people that were involved. After completion of this initial report, one of the three mnemonics (CR, sketch or event-line) was administered. Then participants were asked for a second report, i.e. to verbally reinstate the context, describe the sketch, or describe the event-line.
After the immediate interview all participants were told that they would have to come back again in two weeks’ time. At the beginning of this delayed interview, the same procedure was used as in the immediate interview (instruction to tell the truth/lie, preparation, and pre-interview questionnaire). Participants were then asked to provide a free recall account about the break-in.

It was aimed the same interviewer would conduct both interviews to avoid the risk of an interviewer influencing an interviewee’s accounts. However, some participants were interviewed by different interviewers due to time management issues (e.g. availability of participants, research assistants or interviewers). The majority of participants (81.1%) were interviewed both times by the same interviewer and two interviewers conducted the majority of the interviews (72.0%). To test possible random interviewer effects, total details of the delayed accounts between participants who were questioned by the same interviewer during both interviews with participants who were questioned by the different interviewer during the delayed interview were compared. The difference was not significant, \( t(141) = 0.83, p = .408, d = .19. \)

To achieve that interviewees followed identical instructions during pre-interview and interview phases, scripts were prepared that were required to use in every interview by the research assistants and interviewers.

**Post-interview questionnaire.** After the delayed interview, participants were asked to fill out a post-interview questionnaire. As with the pre-interview questionnaire, truth tellers and liars were requested to respond truthfully. The post-interview questionnaire included questions to assess (again, on 7-point Likert scales) what they thought the likelihood was of getting two credits or £10 and having to write a statement (1 = *not at all*, 7 = *very likely*). In addition, as previous research has shown that active repetition of learned information can buffer against memory decline, participants were asked in an open-ended question how many
times they had tried to remember the break-in (truth tellers)/cover story (liars) in the time between the two interviews. Lastly, participants were asked to assess the extent to which they i) told the truth, and ii) lied during the interview. Answers were given on an 11-point Likert scale ranging from 0% (not at all) to 100% (totally). These two questions were asked twice to assess the truthfulness in both the immediate and delayed interviews.

After completing the questionnaire, participants were thanked and fully debriefed. All participants were paid £10 or given two credits for participation. After completing data collection, one participant was randomly selected as the £150 prize winner.

Noteworthy, to minimise the potential effects of participant collaboration, each interviewee was explicitly instructed to keep the content of the experiment confidential after the immediate interview, also after the completion of the whole study. Each participant was told that revealing the details of the study to the other potential participants may affect their responses in the interviews and, thus, hamper the outcomes of the experiment.

Furthermore, a document was created, in which the names of participants were filled in to avoid possible duplications of volunteers in the further studies.

2.2.5 Coding

Type of details. Interviews were transcribed verbatim. All statements were coded for the details provided by interviewees. Details were counted separately for responses to: 1) free recall (FR); 2) one of three mnemonics in the immediate interviews; and 3) FR in the delayed interviews. Each detail was counted once per question response. For example, if the word ‘table’ was mentioned twice during the FR in the immediate interview (and had the meaning of the same ‘table’), it was counted only once. However, if the same detail was mentioned in the different parts of the interview or different interviews, it was counted separately. Four types of detail were coded: i) visual detail; for example, ‘He’ walked through a double
brown3 door4" contains four visual details; ii) spatial details; for example, ‘There were two doors on either side1 of the corridor and one door in front2, and I was walking behind my colleague3’ contains three spatial details; iii) temporal details; ‘When1 we got there, it took us about a minute2 to open the door, then3 we quickly4 searched the room’ contains four temporal details; and iv) action details; ‘He picked up1 a laptop, we then walked over2 to the entrance door and left3 through that door’ contains three action details. This coding system is based on the Reality Monitoring approach (Johnson & Raye, 1981) and has been used frequently in previous deception research (Vrij, 2008).

Two coders carried out the coding. Both coders were trained by a senior member in the research lab. They received definitions and examples of the to-be-coded variables and were asked to code some practice statements. The trainer gave feedback on the coding and gave the coders a few more practice statements. The coders were given permission to start coding the interviews when the trainer was satisfied with their coding of the practice statements.

The first coder, the author of this study, marked all transcripts. The second coder, blind to the hypotheses, stimulus event, and veracity of the statements, marked a random sample of 29 interview scripts (20.28%) to measure reliability. Inter-rater reliabilities between the two coders for the frequency of detail in the immediate and delayed statements were measured via interclass correlation coefficients (ICC). The ICC revealed excellent inter-rater values of the immediate statements, .98, CI [.95,.99] for visual details; .97, CI [.87,.99] for spatial details; .89, CI [.77,.95] for temporal details; and .95, CI [.73,.98] for action details; and delayed statements, .98, CI [.96,.99] for visual details; .96, CI [.89,.98] for spatial details; .91, CI [.74,.96] for temporal details; and .96, CI [.88,.98] for action details.

**Between-statement consistency.** Consistency in the responses between the immediate FR and delayed FR was measured. The RM details coded previously were used
for consistency analysis. This time details were not split into visual, spatial, temporal, and action details, but the total amount of RM details were examined. A distinction between repetitions (details reported in both immediate and delayed FR), reminiscences (details reported in the delayed FR but not in the immediate FR), and omissions (details reported in the immediate FR but not in the delayed FR) was made. These measures are typically used in deception studies analysing consistencies, as contradictions (the fourth aspect of consistency) do not occur often enough in most experimental deception research to be used in the statistical analyses (e.g. Deeb et al., 2017; Granhag et al., 2016; Granhag & Strömwall, 2002).

The coders only marked reminiscences. Repetitions and omissions were obtained by using arithmetic calculations. Details were coded as reminiscent in the delayed interview if they were not present in the FR of the immediate interview. Repetitions were computed by deducting reminiscences from the total amount of details in the delayed interview and omissions were calculated by deducting repetitions from the total amount of details in the immediate FR.

The same two coders who marked the RM details were used for the consistency coding. The consistency training they received followed a similar format as the training they received for the RM details. Again, the first coder marked all transcripts and the second coder marked 20.28% of the interviews. Inter-rater reliability for reminiscences was only examined because that was the only measure coded manually. The analysis revealed acceptable ICC of .71, CI [.36,.86] reminiscences in the delayed vs. immediate FRs.

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1 One or more contradictions were only present in 42.9% of truthful and in 64.4% of deceptive statements. Although liars’ reports ($M = 2.00, SD = 2.00$) contained more contradictions than truth tellers’ reports ($M = 0.69, SD = 1.06$), $t(141) = 4.53, p < .001, d = 0.82$, there were too few of them in comparison with the other consistency measures in both veracity conditions to make any meaningful conclusions.
2.3 Results

2.3.1 Manipulation checks

Mixed ANOVAs with Interview as the within-subject factor and Veracity as the between-subjects factor were used for all the manipulation checks. Table 2.1 shows mean scores, standard deviations and confidence intervals for truth tellers and liars to the pre- and post- questionnaires.

The Veracity main effect was significant for Stress (liars felt more stressed than truth tellers, $F(1, 138) = 6.47, p = .012, d = 0.43$), Confidence to convince the interviewer (truth tellers felt more confident than liars in their ability to convince the interviewer that they were telling the truth, $F(1, 136) = 28.13, p < .001, d = 0.90$), and How many times they thought about the event/story before the second interview (liars thought more often about the event than truth tellers, $F(1, 140) = 3.92, p = .020, d = 0.40$). These results reflected the theoretical assumption of deception that lying is more mentally taxing task than truth telling (Vrij, 2015).

The Veracity main effect was also significant for Extent of truthfulness (truth tellers were more truthful than liars during both the immediate, $F(1, 139) = 89.05, p = .010, d = 6.29$ and delayed interviews, $F(1, 139) = 65.54, p = .01, d = 5.98$), indicating that participants followed the instructions. All other Veracity main effects were not significant, all $F$’s < 9.14, all $p$’s > .165, see Table 2.1.
Table 2.1

*Means, standard deviations and confidence intervals for the answers to pre-interview and post-interview questionnaires*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Truth</th>
<th>Lie</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Motivation to convince the interviewer</td>
<td>6.15</td>
<td>0.81</td>
</tr>
<tr>
<td>Preparation quality</td>
<td>5.19</td>
<td>1.00</td>
</tr>
<tr>
<td>Preparation time (sec.)</td>
<td>233.68</td>
<td>129.20</td>
</tr>
<tr>
<td>Stress before the interview*</td>
<td>3.29</td>
<td>1.47</td>
</tr>
<tr>
<td>Confidence to convince the interviewer*</td>
<td>5.42</td>
<td>1.02</td>
</tr>
<tr>
<td>Likelihood to receive £10/2 credits*</td>
<td>5.21</td>
<td>1.23</td>
</tr>
<tr>
<td>Likelihood to write a statement</td>
<td>3.51</td>
<td>1.69</td>
</tr>
<tr>
<td>Times thought about the event/story*</td>
<td>2.23</td>
<td>1.27</td>
</tr>
<tr>
<td>Extent of truthfulness in the immediate interview*</td>
<td>99.41</td>
<td>2.37</td>
</tr>
<tr>
<td>Extent of truthfulness in the delayed interview*</td>
<td>98.53</td>
<td>4.32</td>
</tr>
</tbody>
</table>

$p < .05$

Main Interview effects emerged for Motivation, $F(1, 137) = 4.39, p = .038, d = 0.16$. Participants were slightly more motivated before the immediate interview ($M = 6.15, SD = 0.81, 95\% \text{ CI } [5.96,6.35]$) than before the delayed interview ($M = 6.01, SD = 0.93, 95\% \text{ CI } [5.82,6.19]$). However, the means showed that participants were highly motivated before both interviews as their scores were at the upper end of the motivation scale. The Interview main
effect was significant for: Preparation quality, $F(1, 126) = 13.12, p < .001, d = 0.32$;

Participants rated their preparation level higher before the immediate interview ($M = 5.27, SD = 0.98, 95\%\ CI [5.10, 5.44]$) than before the delayed interview ($M = 4.96, SD = 0.93, 95\%\ CI [4.77, 5.15]$); Preparation time, $F(1, 132) = 21.59, p < .001, d = 0.40$.

Participants used more preparation time before the immediate interview ($M = 258.34, SD = 157.85, 95\%\ CI [231.28, 285.39]$) than before the delayed interview ($M = 196.81, SD = 148.50, 95\%\ CI [171.56, 222.06]$); and Stress, $F(1, 138) = 6.48, p = .012, d = 0.19$.

Participants felt more stressed before the immediate interview ($M = 3.74, SD = 1.59, 95\%\ CI [3.48, 4.00]$) than before the delayed interview ($M = 3.44, SD = 1.56, 95\%\ CI [3.18, 3.70]$).

The Interview main effect for Confidence was not significant, $F(1, 136) = 0.03, p = .869, d = 0.02$. Interview effects on quality of preparation, time for preparation, and stress level were probably found because participants were less familiar with the settings before the immediate interview than before the delayed interview.

Significant Veracity x Interview interaction effects emerged for Preparation time, $F(1, 132) = 4.33, p = .039, \eta_p^2 = .03$. However, simple effect ANOVAs revealed no differences between truth tellers and liars in the immediate, $F(1, 132) = 0.34, p = .576, d = 0.10$, and delayed interviews, $F(1, 132) = 2.43, p = .122, d = 0.27$. All other Veracity x Interview interaction effects were not significant, all $F$’s $< 3.93, p > .050$.

A one-way ANOVA with Incentive as the dependent variable revealed a significant main effect for Veracity. Truth-tellers were more convinced than liars that they would receive the full incentive of £10/2 credits, $F(1, 140) = 17.49, p < .001, d = 0.70$, see Table 2.1. A one-way ANOVA with Likelihood to write a statement as dependent variable revealed no significant main effect for Veracity, $F(1, 140) = 1.92, p = .170, d = 0.23$, see Table 2.1. In the two latter analyses, Interview was not included as a factor as the question referred to the two
interviews combined. In summary, the results showed that the manipulations in this study were successful.

2.3.2 Effects of Veracity, Mnemonic type and Interview time on the type of details

To examine whether the amount of information changed between the immediate and delayed interviews, a mixed ANOVA was carried out with Veracity (Truth tellers vs. Liars) and Mnemonic (FR in the CR vs. Sketch vs. Event-line) as the between-subjects factors and Interview (Immediate vs. Delayed) as the within-subject factor. With visual details as dependent variable a significant main effect emerged of Veracity, $F(1, 137) = 22.54, p < .001, d = 0.79$. Truth tellers ($M = 103.09, SD = 35.04, 95\% \text{ CI } [95.38,110.74]$) reported more visual details than liars ($M = 74.40, SD = 37.34, 95\% \text{ CI } [66.73, 83.98]$). The main effect of Interview was also significant, $F(1, 137) = 14.12, p < .001, d = 0.18$. Interviewees reported more visual details immediately after watching the video ($M = 60.74, SD = 26.90, 95\% \text{ CI } [56.55,64.93]$) than after a two-week delay ($M = 55.98, SD = 27.17, 95\% \text{ CI } [51.73, 60.22]$). The Mnemonic main effect was not significant, $F(2, 137) = 0.46, p = .633, \eta^2_p = .01$, neither were the Veracity x Interview, $F(1, 137) = 0.06, p = .633, \eta^2_p = .01$, Mnemonic x Interview, $F(2, 137) = 0.30, p = .744, \eta^2_p = .004$, and Veracity x Mnemonic x Interview, $F(2, 137) = 0.71, p = .495, \eta^2_p = .01$, interaction effects.

A mixed ANOVA with Veracity and Mnemonic as between-subjects factors and Interview as within-subject factor and spatial detail as the dependent variable revealed a significant main effect for Veracity, $F(1, 137) = 49.07, p < .001, d = 1.17$. Truth tellers ($M = 56.42, SD = 23.71, 95\% \text{ CI } [51.23, 62.14]$) reported more spatial details than liars ($M = 32.16, SD = 17.45, 95\% \text{ CI } [28.43, 36.27]$). The main effects for Mnemonic, $F(2, 137) = 1.34, p = .265, \eta^2_p = .02$, Interview, $F(1, 137) = 0.23, p = .636, d = 0.02$, and the Veracity x Interview, $F(1, 137) = 0.03, p = .858, \eta^2_p = .00$, Mnemonic x Interview, $F(2, 137) = 0.70, p = .495, \eta^2_p = .01$, interaction effects.
interaction effects were all not significant.

The same mixed ANOVA with temporal details as the dependent variable revealed a significant main effect for Veracity, $F(1, 137) = 82.78, p < .001, d = 1.56$. Truth tellers reported more temporal details ($M = 26.59, SD = 12.09, 95\% \text{ CI} [23.69, 29.58]$) than liars ($M = 10.99, SD = 7.42, 95\% \text{ CI} [9.33, 12.63]$). The Mnemonic main effect was not significant, $F(2, 137) = 0.33, p = .721, \eta^2_p = .01$. The Veracity x Interview interaction effect was significant, $F(1, 137) = 7.76, p = .006, \eta^2_p = .05$. Truth tellers reported more temporal details in the immediate interview ($M = 18.32, SD = 8.61, 95\% \text{ CI} [16.71, 19.94]$) than in the delayed interview ($M = 16.58, SD = 8.10, 95\% \text{ CI} [14.89, 18.27]$), $F(1, 141) = 8.83, p = .003, d = 0.21$, whereas for liars the amount of temporal information reported did not differ between the immediate ($M = 7.19, SD = 4.86, 95\% \text{ CI} [5.61, 8.78]$) and delayed interviews ($M = 7.73, SD = 6.32, 95\% \text{ CI} [6.07, 9.39]$), $F(1, 141) = 0.85, p = .358, d = 0.10$. There was also a significant Mnemonic x Interview interaction effect, $F(2, 137) = 3.79, p = .025, \eta^2_p = .05$. Interviewees reported more temporal details in the immediate ($M = 12.77, SD = 8.22, 95\% \text{ CI} [10.68, 14.63]$) than in the delayed interview ($M = 11.07, SD = 7.25, 95\% \text{ CI} [9.01, 13.13]$) in the CR condition, $F(1, 140) = 4.98, p = .027, d = 0.22$, whereas the difference in the sketch condition between the immediate ($M = 13.53, SD = 10.54, 95\% \text{ CI} [11.59, 15.47]$) and delayed interview ($M = 12.33, SD = 9.66, 95\% \text{ CI} [10.31, 14.36]$), $F(1, 140) = 2.50, p = .116, d = 0.12$, and in the event-line condition between the immediate ($M = 12.08, SD = 7.80, 95\% \text{ CI} [10.11, 14.06]$) and delayed interview ($M = 13.07, SD = 8.39, 95\% \text{ CI} [11.00, 15.13]$), $F(1, 140) = 1.90, p = .170, d = 0.12$, were not significant. The Veracity x Mnemonic x Interview interaction effect was not significant, $F(2, 137) = 0.09, p = .914, \eta^2_p = .001$. A mixed ANOVA with Veracity and Mnemonic as the between-subjects factors, Interview as the within-subject factor and action details as the dependent variable revealed a
significant main effect for Veracity, $F(1, 137) = 79.09, p < .001, d = 1.48$. Truth tellers reported more action information ($M = 37.30, SD = 14.59, 95\% \text{ CI} [34.33, 40.26]$) than liars ($M = 18.63, SD = 10.16, 95\% \text{ CI} [15.73, 21.54]$). Interview main effect was also significant, $F(1, 137) = 10.78, p = .001, d = 0.15$. Participants reported more action details in the immediate ($M = 28.93, SD = 16.16, 95\% \text{ CI} [26.29, 31.56]$) than in the delayed interview ($M = 26.55, SD = 16.23, 95\% \text{ CI} [23.89, 29.24]$). The Mnemonic x Interview interaction effect was also significant, $F(2, 137) = 3.21, p = .043, \eta^2_p = .05$. In the sketch condition, interviewees reported more action details in the immediate interview ($M = 31.06, SD = 18.88, 95\% \text{ CI} [28.18, 35.41]$) than in the delayed interview ($M = 26.41, SD = 18.95, 95\% \text{ CI} [23.21, 30.98]$), ($F(1, 140) = 14.33, p < .001, d = 0.25$, whereas no differences emerged between the interviews in the CR, $F(1, 140) = 2.93, p = .089, d = 0.15$, and event-line, $F(1, 140) = 0.04, p = .852, d = 0.02$, conditions. The Veracity x Interview, $F(2, 137) = 2.69, p = .103, \eta^2_p = .02$ and Veracity x Mnemonic x Interview interaction effects, $F(2, 137) = 0.12, p = .885, \eta^2_p = .002$, were not significant.

### 2.3.3 Hypotheses testing

**Amount of details in the CR mnemonic.** Hypotheses 1 to 3 predicted that in the delayed interview specific differences between truth tellers and liars would emerge as a function of mnemonic. Table 2.2 shows the results. As predicted in Hypothesis 1, truth tellers reported more visual, spatial, temporal, and action details than liars in the CR condition after a delay. All effect sizes were substantial (from 0.58 to 1.19).

In the CR condition, simple effect ANOVA analyses revealed that truth tellers reported significantly fewer temporal details in the delayed than in the immediate FR, $F(1, 137) = 8.32, p = .005, d = 0.42$ (for means, standard deviations and confidence intervals, see Tables 2.2 and 2.3). For truth tellers, no significant differences emerged between the
immediate and delayed interview for visual, $F(1, 137) = 2.49, p = .117, d = 0.36$, spatial, $F(1, 137) = 0.43, p = .515, d = 0.12$, and action details, $F(1, 137) = 3.42, p = .066, d = 0.33$. Liars in the CR condition did not show a significant difference in reporting visual, $F(1, 137) = 1.90, p = .171, d = 0.44$, spatial, $F(1, 137) = 0.09, p = .228, d = 0.09$, temporal, $F(1, 137) = 0.09, p = .765, d = 0.09$, or action details, $F(1, 137) = 3.42, p = .066, d = 0.19$ between the immediate and delayed interviews. These results partially support Hypothesis 1, in which it was predicted that in the CR condition neither truth tellers nor liars would produce a memory decline in reporting detail after a delay.

**Amount of details in the sketch mnemonic.** Truth tellers reported significantly more visual, spatial, temporal, and action details in the sketch condition than liars, which was not predicted in Hypothesis 2. All effect sizes were substantial (from 0.73 to 1.76), see Table 2.2 (significant findings highlighted in bold).

In the sketch condition, simple effect ANOVAs revealed that truth tellers reported the same amount of visual, $F(1, 137) = 0.17, p = .680, d = 0.07$, and spatial details, $F(1, 137) = 0.01, p = .909, d = 0.02$ in the immediate and delayed interviews. However, truth tellers reported less temporal, $F(1, 137) = 5.72, p = .018, d = 0.60$, and action details, $F(1, 137) = 9.32, p = .003, d = 0.50$ in the delayed interview than in the immediate interview. Liars in the sketch condition reported less visual, $F(1, 137) = 4.08, p = .045, d = 0.30$ and action details, $F(1, 137) = 5.41, p = .022, d = 0.50$ in the delayed interview than in the immediate interview.

Liars showed no difference in reporting spatial, $F(1, 137) = 1.47, p = .228, d = 0.24$, and temporal details, $F(1, 137) = 0.002, p = .968, d = 0.001$, between the immediate and delayed interviews. This provides support for Hypothesis 2 in which it was predicted that in the sketch condition truth tellers, but not liars, would show memory decline in temporal and action details after a delay.
Table 2.2

*RM details in delayed FR as a function of veracity and mnemonic condition*

<table>
<thead>
<tr>
<th>Detail</th>
<th>Truth</th>
<th>Lie</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Visual</td>
<td>62.58</td>
<td>25.21</td>
</tr>
<tr>
<td>Spatial</td>
<td>31.83</td>
<td>13.82</td>
</tr>
<tr>
<td>Temporal</td>
<td>14.83</td>
<td>7.19</td>
</tr>
<tr>
<td>Action</td>
<td>32.83</td>
<td>12.93</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sketch</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual</td>
<td>70.26</td>
<td>35.05</td>
<td>59.69,80.36</td>
<td>48.27</td>
<td>24.53</td>
<td>38.32,58.22</td>
<td>8.97</td>
<td>.003</td>
<td>0.73</td>
</tr>
<tr>
<td>Spatial</td>
<td>41.35</td>
<td>21.63</td>
<td>35.12,47.58</td>
<td>22.50</td>
<td>10.43</td>
<td>16.64,28.36</td>
<td>18.99</td>
<td>&lt;.001</td>
<td>1.11</td>
</tr>
<tr>
<td>Temporal</td>
<td>18.78</td>
<td>8.87</td>
<td>15.84,21.73</td>
<td>5.89</td>
<td>5.36</td>
<td>3.11,8.66</td>
<td>39.72</td>
<td>&lt;.001</td>
<td>1.76</td>
</tr>
<tr>
<td>Action</td>
<td>38.30</td>
<td>19.35</td>
<td>32.64,43.97</td>
<td>15.89</td>
<td>10.72</td>
<td>10.56,21.21</td>
<td>32.53</td>
<td>&lt;.001</td>
<td>1.43</td>
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</table>

<table>
<thead>
<tr>
<th>Event-line</th>
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<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual</td>
<td>64.52</td>
<td>20.28</td>
<td>53.95,75.10</td>
<td>43.13</td>
<td>17.20</td>
<td>32.77,53.48</td>
<td>8.18</td>
<td>.005</td>
<td>1.14</td>
</tr>
<tr>
<td>Spatial</td>
<td>40.87</td>
<td>15.92</td>
<td>34.64,47.10</td>
<td>21.08</td>
<td>12.20</td>
<td>14.98,27.18</td>
<td>20.14</td>
<td>&lt;.001</td>
<td>1.40</td>
</tr>
<tr>
<td>Temporal</td>
<td>16.13</td>
<td>8.04</td>
<td>13.18,19.08</td>
<td>10.00</td>
<td>7.73</td>
<td>7.11,12.89</td>
<td>8.64</td>
<td>.004</td>
<td>0.78</td>
</tr>
<tr>
<td>Action</td>
<td>35.44</td>
<td>14.08</td>
<td>23.77,41.10</td>
<td>20.54</td>
<td>11.67</td>
<td>15.00,26.09</td>
<td>13.81</td>
<td>&lt;.001</td>
<td>1.15</td>
</tr>
</tbody>
</table>

**Amount of details in the event-line mnemonic.** Truth tellers reported significantly more visual, spatial, temporal, and action details than liars in the event-line condition, which was not predicted in Hypothesis 3. All effect sizes were substantial (from 0.78 to 1.40), see Table 2.3.
Table 2.3

**RM details in the immediate FR as a function of veracity and mnemonic condition**

<table>
<thead>
<tr>
<th>Detail</th>
<th>Truth</th>
<th>Lie</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
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<tr>
<td>CR</td>
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<td></td>
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<tr>
<td>Visual</td>
<td>67.46</td>
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<td>33.04</td>
<td>14.04</td>
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<tr>
<td>Temporal</td>
<td>17.71</td>
<td>7.81</td>
</tr>
<tr>
<td>Action</td>
<td>36.08</td>
<td>12.21</td>
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</tbody>
</table>

<table>
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<th>Sketch</th>
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<td>Spatial</td>
</tr>
<tr>
<td>Temporal</td>
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<tr>
<td>Action</td>
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</table>

<table>
<thead>
<tr>
<th>Event-line</th>
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<tbody>
<tr>
<td>Visual</td>
</tr>
<tr>
<td>Spatial</td>
</tr>
<tr>
<td>Temporal</td>
</tr>
<tr>
<td>Action</td>
</tr>
</tbody>
</table>

In the event-line condition, simple effect ANOVAs showed that truth tellers reported significantly less visual details, $F(1, 137) = 5.22, p = .024, d = 0.56$, in the delayed interview than in the immediate interview. Truth tellers showed no difference in reporting spatial, $F(1, 137) = 1.72, p = .192, d = 0.24$, temporal, $F(1, 137) = 0.01, p = .932, d = 0.02$, or action details, $F(1, 137) = 1.14, p = .288, d = 0.20$ between the immediate and delayed interviews. Liars showed no difference in reporting visual, $F(1, 137) = 2.45, p = .120, d = 0.40$, spatial, $F(1, 137) = 0.25, p = .621, d = 0.13$, temporal, $F(1, 137) = 3.54, p = .062, d = 0.39$, or action
Consistency between the immediate and delayed interviews. A 2 (Veracity) x 3 (Mnemonic) analysis of covariance was conducted with reminiscences as the dependent variable and Total detail at immediate FR as a covariate. The reason for including this covariate was that the number of reminiscences in the delayed interview depends on the amount of detail provided in the FR part of the immediate interview. That is, the more detail provided in the immediate FR, the less opportunity to add new detail in the delayed interview. Veracity, $F(1, 131) = 0.61, p = .437, d = .14$, and Mnemonic, $F(2, 131) = 1.50, p = .228, \eta^2_p = .02$ main effects, or Veracity x Mnemonic interaction effect, $F(2, 131) = 0.95, p = .388, \eta^2_p = .01$ were not significant. This showed no support for Hypothesis 4.

A 2 (Veracity) x 3 (Mnemonic) analysis of covariance with repetitions in the delayed interview as dependent variable and Total detail in the immediate FR as covariate did not result in significant main effects for Veracity, $F(1, 131) = 0.71, p = .680, d = .07$, and or Mnemonic, $F(2, 131) = 0.19, p = .831, \eta^2_p = .003$. Although the Veracity x Mnemonic interaction effect was significant, $F(2, 131) = 4.28, p = .016, \eta^2_p = .06$, simple effect analyses showed no significant differences. That is, in the CR condition, truth tellers provided a similar amount of repetitions ($M = 100.21, SD = 43.24, 95\% CI [85.60, 117.29]$) to liars ($M = 105.84, SD = 52.87, 95\% CI [87.73, 122.38]$), $F(1, 43) = 0.68, p = .415, d = 0.12$; in the sketch condition, truth tellers provided a similar amount of repetitions ($M = 106.27, SD = 62.36, 95\% CI [87.57, 128.42]$) to liars ($M = 91.64, SD = 32.27, 95\% CI [76.52, 120.50]$), $F(1,$

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$^2$ Veracity effects without entering Total detail at immediate FR as a covariate are presented in Table 2.4
45) = 4.05, \( p = .05, \ d = 0.29 \); and in the event-line condition, truth tellers reported a similar amount of repetitions (\( M = 111.26, \ SD = 43.74, 95\% \ CI [96.61,125.14]) to liars (\( M = 117.29, \ SD = 41.20, 95\% \ CI [86.71,119.29])\), \( F(1, 43) = 1.11, p = .297, \ d = 0.14 \).

Table 2.4

*Between-statement consistency characteristics as a function of veracity and mnemonic condition (without the addition of covariates)*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Truth</th>
<th>Lie</th>
<th></th>
<th>Truth</th>
<th>Lie</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>95% CI</td>
<td>M</td>
<td>SD</td>
<td>95% CI</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>0.033</td>
<td>0.83</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repetition</td>
<td>119.75</td>
<td>43.24</td>
<td>101.16,138.35</td>
<td>80.30</td>
<td>52.87</td>
<td>61.31,99.30</td>
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<tr>
<td>Repetition</td>
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<td>43.74</td>
<td>118.44,156.43</td>
<td>77.83</td>
<td>37.64</td>
<td>59.24,96.43</td>
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<td>1.46</td>
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<tr>
<td>Omission</td>
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<td>16.48,35.70</td>
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</table>

As the number of omissions was derived from the number of total details minus number of repetitions, a 2 (Veracity) x 3 (Mnemonic) analysis of covariance with omissions as the dependent variable and Total detail at immediate FR as covariate resulted in identical effect sizes (not significant) as in the analysis of repetitions. Thus, Hypothesis 4 was not supported.
2.3.4 Exploratory analysis of type of details in mnemonics

A 2 (Veracity) X 3 (Mnemonic) ANOVA with the number of visual details in the mnemonic part of the immediate interview as the dependent variable revealed a significant main effect for Mnemonic, $F(2, 137) = 6.88, p = .001, \eta_p^2 = .09$. Tukey post-hoc tests showed that interviewees reported significantly more visual details in the sketch condition ($M = 52.63, SD = 28.46, 95\% CI [45.86,60.41]$) than in the CR condition ($M = 32.68, SD = 27.45, 95\% CI [25.43,41.90]$). Participants in the event-line condition ($M = 46.43, SD = 26.03, 95\% CI [39.90,53.79]$) also reported significantly more visual details than participants in the CR condition. There was no significant main effect for Veracity, $F(1, 137) = 2.25, p = .136, d = 0.22$, or a significant Veracity x Mnemonic interaction, $F(2, 137) = 1.96, p = .145, \eta_p^2 = .03$.

A 2 (Veracity) X 3 (Mnemonic) ANOVA with the number of spatial details in the mnemonic part of the immediate interview as the dependent variable revealed a main effect for Veracity, $F(1, 137) = 9.59, p = .002, d = 0.45$. Truth tellers gave more spatial information ($M = 26.87, SD = 20.33, 95\% CI [22.25, 31.80]$) than liars ($M = 19.00, SD = 14.04, 95\% CI [15.97, 22.11]$). The Mnemonic main effect was also significant $F(2, 137) = 12.10, p < .001, \eta_p^2 = .15$. Post-hoc tests revealed that interviewees provided more spatial details in the sketch ($M = 28.67, SD = 16.07, 95\% CI [24.39, 32.94]$) and event-line conditions ($M = 25.87, SD = 19.51, 95\% CI [20.58, 31.91]$) than in the CR condition ($M = 13.77, SD = 14.02, 95\% CI [10.38, 17.50]$). The Veracity x Mnemonic interaction effect was not significant, $F(2, 137) = 3.04, p = .051, \eta_p^2 = .04$.

A 2 (Veracity) X 3 (Mnemonic) ANOVA with the number of temporal details in the mnemonic part of the immediate interview as the dependent variable revealed a significant main effect for Veracity, $F(1, 137) = 10.35, p = .002, d = 0.45$. Truth tellers reported more temporal details ($M = 10.96, SD = 11.07, 95\% CI [8.16, 13.84]$) than liars ($M = 6.75, SD = 13.84$).
7.43, 95% CI [6.01,8.84]). In addition, the Mnemonic main effect was significant $F(2, 137) = 31.85, p < .001, \eta_p^2 = .32$. Post-hoc tests showed that more temporal details were reported in the event-line condition ($M = 16.21, SD = 9.80, 95\% \text{ CI} [13.29, 19.22]$) than in the CR ($M = 5.53, SD = 6.81, 95\% \text{ CI} [3.87,7.38]$) and sketch conditions ($M = 4.86, SD = 7.44, 95\% \text{ CI} [2.98,6.89]$). The Veracity x Mnemonic interaction effect was not significant, $F(2, 137) = 2.76, p = .067, \eta_p^2 = .04$.

A 2 (Veracity) X 3 (Mnemonic) ANOVA with the number of action details as the dependent variable revealed a significant main effect for Veracity, $F(1, 137) = 9.66, p = .002, d = 0.46$. Truth tellers mentioned more action details ($M = 21.63, SD = 21.45, 95\% \text{ CI} [17.21,26.59]$) than liars ($M = 13.40, SD = 13.60, 95\% \text{ CI} [10.33,16.77]$). The Mnemonic main effect was also significant, $F(2, 137) = 20.12, p < .001, \eta_p^2 = .23$. Post-hoc tests revealed that in the event-line ($M = 29.28, SD = 17.97, 95\% \text{ CI} [24.31,34.50]$) condition, interviewees reported more information about actions than in the CR ($M = 12.77, SD = 17.01, 95\% \text{ CI} [8.46,17.68]$) and sketch conditions ($M = 10.53, SD = 13.98, 95\% \text{ CI} [7.04,14.55]$). The Veracity x Mnemonic interaction effect was not significant, $F(2, 137) = 2.21, p = .113, \eta_p^2 = .03$.

None of the interaction effects were significant. However, these interaction effects do not necessarily reflect the specific type of interaction of particular: Comparing the details between truth tellers and liars for the three mnemonic parts of the interview separately. In alignment with Nahari and Ben-Shakhar (2011) and previous deception literature (e.g. Deeb et al., 2017; Shaw et al., 2015) this justifies further examination of the data, specifically, examining the simple Veracity effects for the three mnemonic parts of the interview separately. The results are provided in Table 2.5 (significant findings highlighted in bold).

No significant differences between truth tellers and liars in reporting visual, spatial, temporal, and action details in the CR condition were found. In the Sketch condition, truth
tellers reported more spatial and temporal details than liars. Other mean differences were not significant in this mnemonic group. In the event-line condition, truth tellers provided more visual, spatial, temporal, and action details than liars.

Table 2.5

*Details in the different mnemonic conditions in the immediate interview*

<table>
<thead>
<tr>
<th>Detail</th>
<th>Truth</th>
<th>Lie</th>
<th>95% CI</th>
<th>95% CI</th>
<th>95% CI</th>
<th>95% CI</th>
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<tr>
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<td>22.13,41.86</td>
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<td>9.46,18.90</td>
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<td>.936</td>
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<td>3.59,10.39</td>
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<td>6.02</td>
<td>3.41,8.20</td>
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<td>31.93</td>
<td>40.66,62.55</td>
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<td>.04</td>
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<td>3.48,12.82</td>
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<td>Visual</td>
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<td>30.11,45.89</td>
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<td>12.25</td>
<td>13.77,23.46</td>
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<td>.001</td>
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<td>12.62</td>
<td>16.76,23.16</td>
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<td>7.31</td>
<td>9.83,15.88</td>
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<td>.021</td>
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<tr>
<td>Action</td>
<td>37.30</td>
<td>20.53</td>
<td>29.43,45.64</td>
<td>21.58</td>
<td>10.78</td>
<td>17.78,25.76</td>
<td>11.68</td>
<td>.001</td>
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2.4 Discussion

This study examined how different mnemonic techniques employed in an immediate interview affected delayed statements. In the CR condition, truth tellers provided more visual,
spatial, temporal and action details than liars after a delay. This finding was in line with Hypothesis 1. In addition, as predicted, liars did not show a decline in reporting details over time. Truth tellers, however, showed a decline in reporting temporal details over time, which was not expected, as it was thought that the CR mnemonic would ‘buffer’ the truth tellers against forgetting.

In line with Hypothesis 2, in the sketch condition truth tellers reported more visual and spatial details than liars in the delayed accounts. In addition, truth tellers, but not liars, showed a decline in reporting temporal and action details over time. Two findings were not predicted. First, truth tellers also reported more temporal and action details than liars after a delay, suggesting that when the sketch technique was used, truth tellers provided richer reports in terms of all types of detail. Second, liars also showed a decline in reporting visual and action details. According to the ‘repeat vs reconstruct hypothesis’ (Gran Hag & Strömwall, 1999), liars show a tendency to repeat their stories when interviewed repeatedly. The findings suggest that liars experienced difficulties in mimicking natural memory retrieval that should be produced by truth tellers. A sketch facilitates retrieval of visual and spatial details. Liars did not consider that if the sketch facilitates retrieval of such details, their memories for these details should be less affected than for action and temporal details after a delay (the pattern shown by truth tellers in this study).

In the event-line condition, truth tellers again reported more visual, spatial, temporal, and action details than liars after a delay. As predicted in Hypothesis 3, truth tellers showed a decline in providing visual details, but the predicted decline in reporting spatial details did not occur. In support of Hypothesis 3, liars reported a similar amount of visual, spatial, temporal and action details both immediately and after a delay. Again, truth tellers showed to some extent a natural decline of the details that were less prominent with the event-line
technique (visual details), but liars did not consider that after a delay some details should be better remembered than others.

With regard to consistency between the immediate and delayed statements, no differences in consistency between truth tellers and liars were found, and Hypothesis 4 was therefore rejected. In alignment with previous research (Granhag & Strömwall, 2002; Vredeveldt et al. 2014, Granhag et al., 2016) but in contrast to the widely held stereotypical view (Bogaard et al., 2016), this study showed that truth tellers and liars can be equally consistent in their statements.

Although the study concentrated on comparisons between immediate and delayed accounts, comparisons between the initial and mnemonic parts of the immediate interview were also reported. In brief, it was found that participants in the CR mnemonic performed the worst in eliciting additional detail, and the event-line mnemonic the best. Also, in terms of the ability to discriminate between truth tellers and liars, the CR mnemonic was the least, and the event-line was the most effective mnemonic. Perhaps the event-line mnemonic was the most effective in eliciting information and in distinguishing between truth tellers and liars because the stimulus event (break-in) was dynamic. The entire 5 minute video was full of different activities, and in such a situation the event-line technique might be very helpful for truth tellers in facilitating recall of actions and events, and their temporal order. Liars typically experience an information management dilemma (Granhag & Hartwig, 2008). They are typically motivated to report some information, but not too much. This dilemma might exist even when mnemonics are used in interviews.

The differences between truth tellers and liars were substantial (i.e. effect sizes were high) across all conditions. The findings thus revealed that the ‘richness of detail’ verbal cue remains a diagnostic cue to deceit, even after longer delay periods. This is a novel finding compared with previous studies that showed that truth tellers’ and liars’ accounts became
similar over time (Harvey et al., 2017; Vrij et al., 2009). The important difference between those studies and the current study is that in those studies participants were interviewed only once, either immediately or after the delay, whereas in the current study they were interviewed twice. Perhaps the immediate interview in truth tellers served as a buffer for forgetting in the delayed interview. The use of mnemonics in the immediate interview may have further strengthened this buffer effect.

The findings have important practical implications. First of all, they suggest that using mnemonic techniques during the first interview is helpful in terms of information gathering during subsequent interviews with the interviewee. Furthermore, using mnemonic techniques during the first interview can aid discriminating between truth tellers and liars in subsequent interviews.

The main limitation of this study was that immediate interview across the experimental conditions contained two, report everything and mnemonic, parts. Thus, direct effects of mnemonic techniques used in the immediate interview on delayed statements of truth tellers and liars are unknown. This question will be addressed in Study II of this thesis.

In conclusion, results of this study showed the potential of mnemonic techniques used in the immediate interview to differentiate between truth tellers and liars in the delayed interview based on the amount of detail reported. Also, truth tellers and liars showed similar between-statement consistency.
Chapter 3: Facilitating memory-based lie detection in immediate and delayed interviewing: The role of sketch mnemonic (Study II)
Abstract

Memory enhancing techniques, or mnemonics, are typically recommended in evidence-based investigative interviewing guidelines. In the current study, the use of a sketch mnemonic and its effect on the responses of truth tellers and liars was examined. Participants \((n = 49)\) watched a mock intelligence operation video. They were instructed to tell the truth or lie about this operation in an interview immediately afterwards, and again after a two-week delay. In both interviews participants were requested to make a sketch of the location of the mock operation, and then to verbally describe the drawing. Results revealed that truth tellers reported more visual, spatial, temporal, and action details than liars in the immediate interview. Truth tellers also reported more spatial, temporal and action details than liars in the delayed interview. Truth tellers experienced a decline in reporting action details after the delay, whereas liars did not show a decline in reporting any details over time. Thus, truth-tellers showed patterns of reporting indicative of genuine memory decay, whereas liars produced patterns reflecting a ‘stability bias’. Between-statement consistency did not differ across veracity conditions.
3.1 Introduction

To clarify how the sketch mnemonic was examined in the current study, only participants’ verbal descriptions of the drawings they made were focused on. It was considered that the analysis of verbal details rather than of the sketch itself had higher practical relevance. In an applied setting in which sketching during an interview would be used, it is more likely to expect that the interviewer would ask the interviewee to explain the drawing, than to expect that the interviewer would try to analyse and interpret the drawing him/herself without asking the interviewee to explain the drawing.

The current experiment is an elaboration of Study I (Izotovas et al., 2018) of this thesis. As discussed in Chapter 2 (i.e. Study I), it was found that in each of the three mnemonic conditions, the immediate as well as the delayed truthful statements contained more details than the deceptive statements. However, in Study I the immediate interview consisted of two parts, a free recall phase and a mnemonic phase. Therefore, it was unclear whether the differences between truth tellers and liars in the delayed statements were affected by the free recall, the mnemonic technique or both. In the current study, the effects of a mnemonic technique (sketch) on the delayed statements of truth tellers and liars was directly tested.

Here the sketch technique, in particular, was chosen to examine for three reasons. First, sketching could have more practical value than other mnemonics (for example, traditional context reinstatement) in real life forensic applications. It can be less cognitively demanding for an interviewer to administer a sketch instruction than to formulate questions, and can be protective against incompatible, suggestive/leading questions or retrieval cues during interviews (Dando et al., 2009; Vrij et al., 2010). In one study, the sketch instruction resulted in shorter interviews and, in terms of memory performance, was as effective as the
mental reinstatement of context instruction, and more effective than a standard questioning procedure (Dando et al., 2009). In another study, a sketch produced less confabulations in interviewees’ accounts than standard ‘question-answer’ interviewing approaches (Dando et al., 2011). Similar results were found for a sample of alleged child victims of sexual abuse. Children in the drawing condition disclosed more central details about people, actions, times, and locations of the abusive events than children in the standard interviewing condition (Katz & Hershkowitz, 2010). Furthermore, the sketch mnemonic is positively evaluated by practitioners. For example, in one study, intelligence officers perceived sketching as one of the most effective components of the CI in eliciting information from sources (Rivard et al., 2014).

Second, sketching could be helpful in deception detection because truth tellers should benefit more from specific spatial memory enhancement techniques than liars. The sketch mnemonic should facilitate the retrieval of information for truth tellers. In contrast, liars may lack the imagination or be reluctant to reveal as much information as truth tellers because of the risk that it can be checked by the police (Vrij et al., 2017; Vrij, Fisher, Blank, Leal, & Mann, 2016). In addition, liars tend to plan interviews by anticipating certain questions and preparing answers to them. They may find an interviewer’s request to draw unexpected and, therefore, cognitively demanding to provide detailed accounts after such a request (Vrij et al., 2009).

Third, previous research suggests that sketching aids in eliciting information about the event in question and leads to a better discrimination between truthful and deceptive accounts than standard questions (Vrij et al., 2010; Vrij, Mann, Leal, & Fisher, 2012). A recent review of sketching studies has shown that, in general, this task can promote differences between truth tellers and liars in terms of the amount of provided information (Mac Giolla et al., 2017). However, it is as yet unknown what type of information in a sketch will differentiate
truth tellers from liars the most. In theory, the request to sketch a layout of a crime scene not only forces an interviewee to reveal visual details of objects and/or people, but also to indicate the spatial location of these objects/people (Vrij et al., 2012). Thus, truth-tellers’ memory retrieval of visual or spatial information should be facilitated (Fisher & Geiselman, 1992). Regarding liars’ accounts, sketching can create problems for them because sketching and describing specific objects at specific locations increases the risk of getting caught (Vrij et al., 2012). Therefore, liars may decide to avoid mentioning some visual and spatial details in their accounts. Although previous studies show the efficacy of the sketch to differentiate truth tellers from liars in a single interview (Mac Giolla et al., 2017), it is yet unknown whether this mnemonic can be helpful to detect deception in repeated interviewing contexts. Hence, this was addressed during this experiment.

3.1.1 Sketching and consistency as a cue to deceit

Deception research using sketches and how they affect consistency in truth tellers’ and liars’ accounts is limited. In one study, truth tellers and liars were interviewed about a lunch they supposedly had in a nearby restaurant (Leins, Fisher, Vrij, Leal, & Mann, 2011). They were asked to sketch the layout of the restaurant and to answer a few spatial questions. The consistency between verbal reports and sketches made by truth tellers and liars was examined. Liars were less consistent than truth tellers and more than 80% of truth tellers and 70% of liars were classified correctly based on their consistency scores (Leins et al., 2011). In another study, it was found that drawings elicited less consistent answers from pairs of deceptive suspects than from pairs of truthful suspects, whereas no difference in consistency was found in verbal responses (Vrij et al., 2009). In another experiment, adolescent participants had to either tell the truth or lie in groups of three about an alleged event (Roos af Hjelmsäter et al., 2014). The difference in consistency between truth tellers and liars was
larger for the sketch task than for the verbal descriptions, and triads of liars were less consistent than triads of truth tellers.

It is important to consider that, depending on the interview style, consistency can be either a cue of deceit or a cue of truthfulness (Leins et al., 2010). When a passive interview style is employed (e.g. asking a suspect the same questions from one interview to another), liars are more consistent than truth tellers as a result of liars’ strategies (e.g. planning interviewers’ questions and foreseeing answers to them; Hartwig et al., 2007), and the nature of truth tellers’ memory (Schacter, 1999). In contrast, active interview styles (e.g. asking unanticipated questions, changing interviewing modalities from verbal to pictorial descriptions) constrains liars from using the ‘repeat’ strategy and typically induces inconsistent answers (Leins et al., 2011). Therefore, consistency becomes a diagnostic cue of credibility.

3.1.2 Hypotheses

In this experiment, all participants made a sketch, which they subsequently described. Of interest was the differences between truth tellers and liars in the contents of their descriptions in immediate and delayed interviews. It was expected that truth tellers would report more visual, spatial, temporal, and action details than liars in the immediate accounts (Hypothesis 1). The following two hypotheses were derived from previous findings (Izotovas et al., 2018). As truth tellers could sketch and report these details (i.e., have memory practice) in a sketch, it was further predicted that truth tellers would report more visual and spatial details than liars after a delay (Hypothesis 2). It was expected that truth tellers, but not liars, would show a memory decline in temporal and action details after a delay. Truth tellers would show a decline in such details because of a lack of practicing temporal and action details in sketch descriptions (Hypothesis 3). Regarding between-statement consistency
characteristics, the interviewing approach employed was considered as passive. Although participants were requested to sketch the layout of an incident, only verbal descriptions of the sketches were examined. Moreover, participants were asked the same question twice. In line with the reasoning above, it was predicted that truth tellers would be less consistent than liars: to include the same number of repetitions, but more reminiscences and omissions than liars in the delayed interviews (Hypothesis 4).

3.2 Method

3.2.1 Participants

A total of 49 university students took part in the study. A post hoc power analysis showed that this study had enough power (Cohen, 1992) of 0.93 to obtain medium effect sizes. The mean age of participants was 19.65 years ($SD = 3.36$) and 79.6% were female. Participants were recruited via posters, flyers, the online participant pool system, and online advertisements on the University’s staff portals. As the experiment focused on the verbal content of the statements, native English speakers were prioritised to take part. The majority of participants (93.9%) were English native speakers and the remaining participants were fluent in English. Participants were awarded with two course credits or £10 after they completed the experiment. In addition, all participants were entered into a draw to win a single prize worth £150 after completion of data collection for this study. The experiment was accepted by the Science Faculty Ethics Committee of the University.

The possibility of the duplication of participants was eliminated by checking the documented list of individuals who participated in Study I and making sure they were not invited to participate in Study II. Hence, the current study were volunteers who had not
participated in the previous study. A document with the names of participants of this study was also created for the same purpose.

3.2.2 Design

A 2 (Veracity: Truthful vs deceptive) X 2 (Time of Interview: Immediate vs delayed) experimental design was used with Veracity as between-subjects factor and Time of Interview as within-subjects factor. Dependent variables were visual, spatial, temporal, and action details. Interviewees were randomly assigned as truth tellers (n = 25) or liars (n = 24). All participants were interviewed on two occasions, immediately after the stimulus event and two weeks later. As not all participants were available exactly 14 days after the first interview, the delay period for the second interview varied between 12 and 18 days (M = 13.90, SD = 0.82, Mode = 14 (81.6% of cases). The delay period between truth tellers (M = 13.84, SD = 0.55, 95% CI [13.61, 14.05]) and liars (M = 13.96, SD = 1.04, 95% CI [13.58, 14.43]) was not significantly different, t(47) = 0.50, p = .620, d = .14.

3.2.3 Materials

Stimulus event. Participants watched the same filmed event showing a simulated break-in as in Study I. They were instructed to take the role of an intelligence officer working undercover with another officer. They were told their task was to break into an apartment and secure some important information for intelligence gathering. This special task was recorded from the perspective of the participant who followed the other intelligence officer throughout the break-in. To minimise the possibility of liars telling an embedded lie (for example, by describing the apartment they genuinely lived in), all interviewees were told that the apartment they broke into was a staff room of a community centre.
3.2.4 Procedure

Pre-interview phase. After watching the break-in video participants were randomly assigned to the truth telling or lying condition. Truth tellers were told that the break-in was successful and that they would be interviewed by a fellow agent to continue the intelligence investigation. They were asked to tell the truth during the interview about 1) the interior of the staff room in the video, and 2) what they took from there. Liars where also told that the break-in was successful. However, they were told that they would be interviewed by an agent of a hostile organisation and that their task was to create a convincing cover story because if the hostile officer came to know where exactly they broke in and exactly what was taken from the apartment, the entire investigation would be in danger. Therefore, liars were instructed to tell the hostile officer that they broke into a different staff room in a different community centre. They had to lie about 1) the interior of the apartment in the video, and 2) what they took from there. To increase participants’ motivation to be convincing in the interviews, they were told that only if they were convincing during the interview, would they receive two course credits or £10 and entered in the draw to win a £150 worth prize. Participants were also informed about the consequences for not being believed in the interviews. Specifically, they were told that if the interviewer thought that they did not report everything they remembered, they would only receive one course credit or £5, would be excluded from the draw, and would be asked to write a full statement of what happened in the video.

After the instructions to tell the truth or lie, participants were requested to prepare for the interview. They were given unlimited preparation time. After preparation, they were given a pre-interview questionnaire. Truth tellers and liars were requested to respond truthfully. In the questionnaire participants were asked to rate on 7-point scales their preparation for the interview. They were asked to indicate how well they were prepared (1 =
very poor, 7 = very good) and how sufficient (1 = insufficient, 7 = sufficient); and complete (1 = incomplete, 7 = complete) their preparation was. These three preparation items were clustered into one variable, Preparation quality (Cronbach’s alpha is .91 for the immediate and .93 for the delayed interviews). The pre-interview questionnaire also included questions about stress, motivation, and confidence the participants felt about being convincing in the upcoming interview. These answers were rated on 7-point scales (1 = not at all, 7 = totally).

**Interviews. Sketch Task.** One interviewer, blind to the aims of the study, stimulus material, and veracity conditions, questioned the participants. In the beginning of the immediate interview truth tellers and liars were asked to sketch the layout of the community centre they broke into. The participants made their drawing on an A3 sized blank sheet of paper. They were requested to use as much space as they needed to sketch the scene as they remembered it. Participants were instructed to include as many details as possible about where different objects were in relation to other objects. They could also use labels and notes within their sketch to indicate the features of the scene or to indicate if they were not certain of something. After making the sketch, participants were asked to describe it in as much detail as possible.

After the immediate interview all participants were told that the second part of the experiment would be in two weeks’ time. When they came back for the second session, participants were again given the same sketch task, and, afterwards, asked to verbally describe their sketch.

**Post-interview questionnaire.** Participants were asked to fill out a post-interview questionnaire after the delayed interview only. The post-interview questionnaire included questions about what they thought the likelihood was of getting two credits or £10 and having to write a statement (1 = not at all, 7 = very likely). As previous research has found that active repetition of learned information can prevent memory decline (Bornstein et al., 1998),
participants were also asked in an open-ended question how many times they had tried to remember the break-in (truth tellers)/cover story (liars) between the two interviews. Lastly, participants were asked about the extent to which they i) told the truth, and ii) lied during the interview. Participants indicated on 11-point Likert scales ranging from 0% (not at all) to 100% (totally). These two questions were asked twice to assess the truthfulness in both the immediate and delayed descriptions of the sketch. As with the pre-interview questionnaire, truth tellers and liars were requested to be honest with their responses.

After completing the post-interview questionnaire, all participants were thanked, fully debriefed, and paid £10 or given two credits for participation in the experiment. After full data collection, one participant was randomly selected as a lottery winner.

Noteworthy, to minimise the potential effects of participant collaboration, each interviewee was explicitly instructed to keep the content of the experiment confidential after the immediate interview, and again after completion of the whole study.

3.2.5 Coding

Verbal details. Interviews were transcribed verbatim. All statements were coded for the details provided by interviewees in the 1) immediate sketch description and 2) delayed sketch description. Each detail was counted once per description of sketch. For example, if the same word ‘desk’ (or a synonym) was mentioned twice in one interview (and had the meaning of the same ‘desk’), it was counted only once. However, if the same detail was mentioned in the different interviews, it was counted separately. Four types of detail were coded: visual, spatial, temporal, and action details.

Two coders carried out the coding. Both coders were trained by a senior member in the research lab. They received definitions and examples of the to-be-coded variables and were asked to code some practice statements. The trainer gave feedback on the coding and
gave the coders a few more practice statements. The coders were given permission to start coding the study interviews when the trainer was satisfied with their coding of the practice statements.

The first coder, the author of this study, coded all transcripts. The second coder, blind to the hypotheses, stimulus event, and veracity of the statements, coded a random sample of 12 interview scripts (24.5%) to measure reliability. Inter-rater reliabilities between the two coders for the frequency of detail in both (immediate and delayed) statements were measured via intraclass correlation coefficients (ICC). The ICC revealed acceptable inter-rater values of the immediate statements, .70, CI [-.27,.91] for visual details; .94, CI [.82,.99] for spatial details; .71, CI [.10,.92] for temporal details; and .82, CI [.40,.95] for action details; and delayed statements, .83, CI [.40,.95] for visual details; .77, CI [.17,.93] for spatial details; .67, CI [-.06,.91] for temporal details; and .85, CI [.51,.96] for action details.

**Between-statement consistency.** Consistency in the responses between the immediate and delayed verbal descriptions of sketch was measured. The details coded previously were used for consistency analysis. The total amount of details (visual, spatial, temporal, and action details combined) was examined. Repetitions (details reported in both immediate and delayed sketch), reminiscences (details reported in the delayed but not in the immediate sketch), and omissions (details reported in the immediate but not in the delayed sketch) were analysed.

The coders only coded reminiscences. Arithmetic calculations were used to obtain repetitions and omissions. Reminiscent details in the delayed interview were coded if they were not present in the immediate interview. Repetitions were computed by deducting

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3 As in Study I, contradictions, the fourth measure of consistency, did not occur often enough in the reports of truth tellers and liars. One or more contradictions were present in 36.0% of truthful statements and 50.0% of deceptive statements. They were rare for truth tellers ($M = 0.44$, $SD = 0.65$) and liars ($M = 0.79$, $SD = 0.93$), and did not differ significantly across veracity groups, $t(141) = 1.53$, $p = .131$, $d = 0.51$. 
reminiscences from the total amount of details in the delayed interview and omissions were calculated by deducting repetitions from the total amount of details in the immediate interview.

Again, two coders were used for the consistency coding. The consistency training they received followed a similar format as the training they received for the details coding. The first author marked all transcripts and the second coder marked 11 interview scripts, 22%. Inter-rater reliability for reminiscences was examined only because that was the only measure coded manually. The analysis revealed high ICC of .87 for reminiscences in the delayed vs. immediate reports.

3.3 Results

3.3.1 Manipulation checks

Mixed ANOVAs with Time of Interview as the within-subjects factor and Veracity as the between-subjects factor were used for all the manipulation checks. Table 3.1 shows mean scores, standard deviations and confidence intervals for truth tellers and liars to the pre- and post- questionnaires.

There was a significant main effect of Veracity on self-reported stress levels, $F(1, 47) = 6.44, p = .014, d = 0.72$. Liars reported feeling a higher level of stress than the truth tellers did. There was also a significant main effect of Veracity on confidence in convincing the interviewer, $F(1, 47) = 7.54, p = .016, d = 0.65$. Truth tellers felt more confident than liars in their ability to convince the interviewer that they were telling the truth. A significant main effect of Veracity was found on how many times interviewees thought about the event/story before the second interview, $F(1, 46) = 3.41, p = .028, d = 0.63$. Liars thought more often about the event than truth tellers. There were also significant main effects of Veracity on
extent of truthfulness during the immediate interview, $F(1, 47) = 52.10, p < .001, d = 5.8$, and the delayed interview, $F(1, 46) = 91.90, p < .001, d = 5.57$.

Table 3.1

Means, standard deviations and confidence intervals for the answers to pre-interview and post-interview questionnaires from truth-tellers and liars

<table>
<thead>
<tr>
<th>Measure</th>
<th>Truth tellers</th>
<th>Liars</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Motivation to convince the interviewer</td>
<td>6.04</td>
<td>0.72</td>
</tr>
<tr>
<td>Preparation quality</td>
<td>4.96</td>
<td>0.80</td>
</tr>
<tr>
<td>Preparation time (sec.)</td>
<td>198.85</td>
<td>98.27</td>
</tr>
<tr>
<td>Stress before the interview*</td>
<td>3.39</td>
<td>1.33</td>
</tr>
<tr>
<td>Confidence to convince the interviewer*</td>
<td>5.17</td>
<td>1.01</td>
</tr>
<tr>
<td>Likelihood to receive £10/2 credits</td>
<td>5.23</td>
<td>1.21</td>
</tr>
<tr>
<td>Likelihood to write a statement</td>
<td>3.46</td>
<td>1.48</td>
</tr>
<tr>
<td>Times thought about the event/story*</td>
<td>2.19</td>
<td>1.27</td>
</tr>
<tr>
<td>Extent of truthfulness in the immediate interview*</td>
<td>98.46</td>
<td>6.13</td>
</tr>
<tr>
<td>Extent of truthfulness in the delayed interview*</td>
<td>98.92</td>
<td>6.24</td>
</tr>
</tbody>
</table>

*p < .05

In both interviews, truth tellers were more truthful than liars. All other main effects of Veracity were not significant, all $F’s < 9.14$, all $p’s > .165$, see Table 3.1.
A main effect of Time of Interview emerged only for preparation time, $F(1, 46) = 14.80, p < .001, d = 0.59$. Participants used more preparation time before the immediate interview ($M = 234.14, SD = 99.69, 95\% CI [208.54, 260.49]$) than before the delayed interview ($M = 178.45, SD = 99.69, 95\% CI [154.14, 201.83]$). All other main effects of Time of Interview were non-significant, all $F’s < 3.70, all p’s > .060$. All Veracity x Time of Interview interaction main effects were not significant, all $F’s < 1.45, p > .234$.

An independent $t$ test revealed no significant main effect of Veracity on incentive ratings. Truth tellers were equally convinced as liars about getting a £10/2 credits reward, $F(1, 38) = 0.02, p = .10, d = 0.48$. Finally, an independent $t$ test revealed no significant main effect of Veracity on the likelihood of writing a statement ratings, $F(1, 38) = 1.89, p = .10, d = 0.49$, see Table 3.1 (In the two latter analyses time of interview was not included as a factor as the question referred to the two interviews combined). In summary, the results showed that manipulations in this study were successful.

### 3.3.2 Verbal details in the immediate and delayed interviews

To examine whether the amount of information changed between the immediate and delayed interviews, mixed ANOVAs were carried out with Time of Interview as the within-subject factor and Veracity as the between-subjects factor. With visual details as dependent variable, there was a significant main effect of Veracity, $F(1, 47) = 6.73, p = .013, d = 0.74$, with truth tellers ($M = 106.56, SD = 46.58, 95\% CI [89.73, 126.19]$) reporting more visual details than liars ($M = 75.79, SD = 35.31, 95\% CI [62.17, 91.80]$). The main effect of Time of Interview, $F(1, 47) = 0.05, p = .817, d = 0.03$, and Veracity x Time of Interview interaction, $F(1, 47) = 3.95, p = .053, \eta^2_p = .08$, were not significant. Simple effects analysis for Veracity revealed that truth tellers reported more visual details than liars in the immediate
interview, whereas the difference was not significant in the delayed interview, see Table 3.2. The other simple effects for Veracity or Time of Interview did not reach significance.

A significant main effect of Veracity emerged for reporting spatial details, $F(1, 47) = 15.97, p < .001, d = 1.15$. Truth tellers ($M = 56.40, SD = 30.47, 95\% \text{ CI } [45.54, 68.92]$) reported more spatial details than liars ($M = 28.54, SD = 15.73, 95\% \text{ CI } [22.30, 35.50]$). The main effect of Time of Interview was not significant, $F(1, 47) = 0.05, p = .820, d = 0.01$, but the Veracity x Time of Interview interaction effect, $F(1, 47) = 5.27, p = .026, \eta^2_p = .10$, was significant. Simple effects showed that truth tellers reported more spatial details than liars in both the immediate and delayed interviews (Table 3.2).

A significant main effect of Veracity emerged for temporal details, $F(1, 47) = 8.50, p = .005, d = 0.84$. Truth tellers ($M = 14.76, SD = 19.74, 95\% \text{ CI } [8.05, 23.86]$) reported more temporal details than liars ($M = 2.79, SD = 3.91, 95\% \text{ CI } [1.30, 4.39]$). The Time of Interview main effect, $F(1, 47) = 0.04, p = .840, d = .01$, and Veracity x Time of Interview interaction effect, $F(1, 47) = 1.00, p = .323, \eta^2_p = .02$, were not significant. Simple effects revealed that truth tellers reported more temporal details than liars in both the immediate and delayed interviews (Table 3.2).

A significant main effect of Veracity emerged for action details, $F(1, 47) = 10.78, p = .001, d = 0.98$. Truth tellers ($M = 32.84, SD = 36.47, 95\% \text{ CI } [20.12, 48.87]$) mentioned more action details ($M = 6.92, SD = 8.56, 95\% \text{ CI } [3.81, 10.21]$) than liars. The Time of Interview main effect was not significant, $F(1, 47) = 1.89, p = .176, d = .08$, but the Veracity x Time of Interview interaction effect was significant, $F(1, 47) = 5.42, p = .024, \eta^2_p = .10$. Simple effects revealed that truth tellers provided more action details than liars in both the immediate and delayed interviews, see Table 3.2.
Table 3.2

Details in the immediate and delayed sketch reports as a function of veracity condition

<table>
<thead>
<tr>
<th>Detail</th>
<th>Truth</th>
<th>Lie</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Immediate interview</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual</td>
<td>55.68</td>
<td>27.19</td>
</tr>
<tr>
<td>Spatial</td>
<td>29.24</td>
<td>16.51</td>
</tr>
<tr>
<td>Temporal</td>
<td>7.60</td>
<td>9.69</td>
</tr>
<tr>
<td>Action</td>
<td>18.04</td>
<td>20.68</td>
</tr>
<tr>
<td>Delayed interview</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual</td>
<td>50.88</td>
<td>20.90</td>
</tr>
<tr>
<td>Spatial</td>
<td>27.16</td>
<td>14.77</td>
</tr>
<tr>
<td>Temporal</td>
<td>7.16</td>
<td>10.24</td>
</tr>
<tr>
<td>Action</td>
<td>14.80</td>
<td>16.32</td>
</tr>
</tbody>
</table>

In summary, as predicted in Hypothesis 1, truth tellers reported significantly more visual, spatial, temporal, and action details than liars in the immediate statements, with large Cohen’s d effect sizes for independent samples ranging from 0.88 to 1.21. Truth tellers also reported significantly more spatial, temporal, and action details after a delay. The effect sizes samples were again large, ranging from 0.75 to 0.93. There was no difference between truth tellers and liars in the amount of visual details after a delay. Thus, Hypothesis 2 was supported for spatial details, but rejected for visual, temporal, and action details.

Hypothesis 3 predicted a memory decline in truth tellers for temporal and action details after a delay. Truth tellers showed a significant decline in reporting action details, $F(1, 47) = 7.00, p = .045, d = .42$ (Cohen’s d for paired samples), but no difference in reporting visual, spatial, and temporal details emerged between immediate and delayed statements, all $F’s < 2.52, p’s > .088, d’s < 0.38$. There was no difference between liars’ immediate and
delayed statements in the amount of any type of (visual, spatial, temporal, or action) detail, all $F$’s $< 3.13$, $p$’s $>.080$, $d$’s $< 0.37$. Thus, Hypothesis 3 was supported for action details, but rejected for temporal details.

Reporting patterns of different type of details over time in the statements of truth tellers and liars are shown in Figure 3.1. Although not significant (except for action details), truth tellers showed a tendency to report a lower amount of details in the delayed than in the immediate interviews. In contrast, liars showed a non-significant tendency to report more visual, spatial, temporal, and action details in the delayed than in the immediate interviews.

![Figure 3.1. Amount of reported details with 95% confidence intervals in the immediate and delayed statements across veracity conditions.](image)

* $p < .005$

To support overall patterns of reporting details over time, it was considered important to examine the effects on total details across veracity groups. A mixed ANOVA was carried out with Time of Interview as the within-subject factor and Veracity as the between-subjects
factor and total details as the dependent variable. There was a significant Veracity x Interview interaction main effect for total details, $F(1, 47) = 6.30, p = .016, \eta^2_p = .12$. Truth tellers reported significantly more total details in the immediate statements ($M = 110.56$, $SD = 70.87$, 95% CI [86.57, 140.43]) than in the delayed statements ($M = 99.96$, $SD = 58.79$, 95% CI [79.58, 123.75]), $t(24) = 2.26, p = .034, d = .45$. Liars showed no difference in reporting total details between the immediate statements ($M = 53.46$, $SD = 25.15$, 95% CI [43.56, 62.96]) and delayed statements ($M = 60.75$, $SD = 34.13$, 95% CI [47.77, 75.83]), $t(23) = 1.36, p = .189, d = .28$.

3.3.3 Consistency between the immediate and delayed interviews

An ANCOVA with Veracity as the between-subjects factor was conducted with reminiscent details as the dependent variable and amount of detail provided at the immediate interview as a covariate. The reason for including this covariate was that the number of reminiscent details in the delayed interview is related to the amount of detail provided in the immediate interview. That is, the more detail provided in the immediate interview, the less opportunity there is to add new additional detail in the delayed interview. The main effect of Veracity was not significant, $F(1, 45) = 1.89, p = .176, d = .54$. Truth tellers ($M = 18.41$, $SD = 25.20$, 95% CI [13.41, 23.76]) and liars ($M = 30.71$, $SD = 36.20$, 95% CI [17.46, 53.60]) provided a similar number of reminiscent details in the delayed interview.

The same ANCOVA with repetitions in the delayed interview as the dependent variable and amount of detail provided at immediate interview as a covariate did not result in a significant main effect of Veracity, $F(1, 46) = 0.20, p = .654, d = .22$. Truth tellers ($M = 59.41$, $SD = 14.65$, 95% CI [46.90, 73.28]) and liars ($M = 55.43$, $SD = 21.07$, 95% CI [43.12, 68.82]) reported a similar number of repetitions in the delayed interview.
The ANCOVA with omissions as the dependent variable and Total detail at the immediate interview as a covariate showed no significant effect of Veracity either, $F(1, 46) = 0.20, p = .654, d = .22$. Truth tellers ($M = 23.12, SD = 14.65, 95\%\ CI [16.06, 30.37]$) and liars ($M = 27.17, SD = 21.07, 95\%\ CI [20.28, 37.18]$) omitted a similar number of details in the delayed interview\(^4\). Thus, Hypothesis 4 was not supported.

### 3.4 Discussion

In this experiment, the effects of a sketch mnemonic on immediate and delayed statements of truth tellers and liars were examined. Analysis of the immediate descriptions of the sketch revealed that truth tellers reported significantly more visual, spatial, temporal, and action details than liars. This result is in line with previous findings showing that truth tellers, especially when interviewed immediately after an event, report more information than liars (Vrij, 2005, 2008, 2016).

In the delayed sketch descriptions, truth tellers provided more spatial, but not more visual details than liars. Moreover, the statements of truth tellers were comparatively richer in terms of temporal and action details than the liars’ statements.

Two conclusions can be derived from the findings for the delayed statements. First, the credibility cue richness of detail remained diagnostic after a delay (except for visual details). These findings differed from those obtained in some other studies (e.g., Harvey et al., 2017; Vrij et al., 2009) in which truth tellers did differ from liars in the amount of

\(^4\) When the amount of total detail in the immediate interview was not included as a covariate, an independent $t$ tests revealed that truth tellers ($M = 19.44, SD = 11.39, 95\%\ CI [15.38, 23.80]$) and liars ($M = 24.63, SD = 31.13, 95\%\ CI [14.86, 38.56]$) reported a similar number of reminiscent details in the delayed interview, $F(1, 47) = 0.61, p = .439, d = 0.22$. Truth tellers ($M = 80.52, SD = 55.87, 95\%\ CI [59.54, 104.69]$) provided significantly more repetitions than liars ($M = 36.13, SD = 18.68, 95\%\ CI [28.87, 43.89]$) in the delayed interview, $F(1, 47) = 13.68, p = .001, d = 1.07$. Also, truth tellers ($M = 30.04, SD = 24.20, 95\%\ CI [21.19, 39.96]$) made significantly more omissions than liars ($M = 17.33, SD = 11.98, 95\%\ CI [12.75, 21.52]$ in the delayed interview, $F(1, 47) = 5.35, p = .025, d = 0.67$.}
information provided when interviewed immediately, but not after a delay. Noteworthy, in those studies participants were interviewed only once, and no mnemonic was used. Thus, the presence of an immediate interview and/or the use of a mnemonic may have strengthened memory in truth tellers and, subsequently, made richness of detail a diagnostic cue to deceit even in delayed interviews.

Second, the absence of a difference in the amount of visual details across veracity conditions in the delayed interviews could be explained by different reporting strategies. Truth tellers might have been forthcoming in their delayed statements and simply reported what they remembered. Liars might have found it easier to report more visual details than the other types of detail. Providing visual information is relatively safe as it does not give too many leads to investigators and implicate the interviewee. For example, liars can provide visual details that are typically found in a staff room e.g. information about furniture, kitchen utensils, or electric devices. Accounts with such information are less likely to contradict the factual evidence. However, reporting too many spatial, temporal or action details might have put liars at risk of revealing self-incriminating evidence. For example, information about locations of objects, specific times and/or activities can be potentially checked by investigators (e.g. CCTV records or asking neighbours who could have witnessed the event in question). It is known that liars tend to avoid reporting self-incriminating evidence (Granhag & Hartwig, 2008). More research is needed to support this explanation with more confidence.

It was further found that truth tellers showed a significant decline in providing action and total details between the immediate and delayed interviews. Liars showed no decrease in reporting any type of details in this study. It supports the evidence that truth tellers experienced genuine decline in memory over time (Ebbinghaus, 1885/1913; Penrod et al., 1982; Schacter, 1999), whereas liars failed to take into account genuine memory decay and produced the reporting pattern reflecting a ‘stability bias’ (Harvey et al., 2017).
Finally, there was no difference in between-statement consistency across veracity conditions. As in previous research (Granhag & Strömwall, 2002; Vredeveldt et al. 2014, Granhag et al., 2016), this experiment showed that truth tellers and liars were equally consistent in their statements. This finding is in contrast with the widely held stereotypical view that truth tellers are more consistent than liars (Bogaard et al., 2016). Two explanations can be derived from the lack of difference in consistency between truth tellers and liars in their repeated statements. First, truth tellers could not only add or omit, but also repeat a lot of details because their immediate and delayed statements were rich in detail, in general. Second, and in line with previous research (Leins et al., 2012), liars may not experience difficulty in being consistent between their statements because a passive interviewing style (identical request of making a sketch during both interviews) was employed in this study. The modalities of interview were not changed, therefore, liars were not constrained to use the ‘repeat’ strategy during the delayed interview.

A limitation of this study was that it did not contain a control condition. It is therefore difficult to identify whether the immediate use of sketch did produce differences between truth tellers and liars after a delay. The immediate interviewing, regardless of the techniques used in it, could also similarly affect delayed accounts of truth tellers and liars. This issue will be addressed in Study III of this thesis.

In conclusion, the results of this experiment showed that the sketch mnemonic was helpful to differentiate between truthful and deceptive statements in the immediate and delayed interviews. In addition, truth tellers showed a decline in reporting some of the details between the immediate and delayed interviews. Liars, instead, provided a similar amount of detail over time. Finally, truthful and deceptive statements did not differ in terms of between-statement consistency.
Chapter 4: Deception detection in repeated interviews: The
effects of immediate type of questioning on delayed accounts

(Study III)
Abstract

In criminal investigation settings, the proper use of interviewing techniques is important to gather relevant and reliable information, and to effectively infer the credibility of an interviewee’s account. In this study, how different types of interviewing used in an interview conducted shortly after an event affected truth tellers’ and liars’ responses when they were interviewed again after a two-week delay was investigated. Participants (n = 80) were shown a mock intelligence operation video and instructed either to tell the truth or lie about its contents in two interviews, one of which took place immediately after watching the video and the other after a two-week delay. In the immediate interview participants were instructed either to report everything they remembered, or asked open-ended spatial questions related to the event. In the delayed interview all participants were asked to report everything they could remember. Truth tellers reported more visual, spatial, temporal and action details than liars, both immediately and after a delay in both interviewing groups. However, the differences between truth tellers and liars were slightly larger in the report everything than spatial questions condition. Truth tellers provided more reminiscences and repetitions, but made fewer omissions than liars in the delayed accounts. Results suggest that an immediate ‘report everything’ mnemonic technique can provide a buffer against truth-tellers’ decline in reporting details after a delay, and effectively discriminate between truthful and deceptive accounts.
4.1 Introduction

The goal of any successful police investigation is to obtain reliable evidence for court proceedings (Gabbert, Hope, Carter, Boon, & Fisher, 2016; Milne & Bull, 1999). The testimony of witnesses and victims plays an important role in criminal investigations, and so information collected from them in interviews must be both accurate and relevant to the case (Walsh & Oxburgh, 2008). Research has shown that the way in which a witness is questioned can affect the quality of his/her statement (Loftus & Palmer, 1974; Memon, Meissner, & Fraser, 2010). Inappropriate questioning during the investigative interview may result in memory distortions or incomplete or erroneous reports from interviewees, which may significantly deteriorate an investigation (Clarke & Milne, 2001; Oxburgh, Myklebust & Grant, 2010). Moreover, poor questioning can impair possibilities to reliably discriminate between truthful and deceptive reports, meaning lies remain undetected (Vrij & Granhag, 2012).

In the legal system interviewees tend to be interviewed multiple times about the target event, often after long delay periods (Pansky et al., 2005; Wysman et al., 2014). In the current research, how the initial type of questioning affects the content and credibility of the subsequent delayed accounts was examined.

The current experiment is an elaboration of Study I (Chapter 2; Izotovas et al., 2018) and Study II (Chapter 3) of this thesis. Specifically, although the results of Studies I and II indicated that mnemonic techniques used in the immediate interview can be helpful in differentiating truth tellers from liars after a delay, it cannot be said with certainty what effect was a consequence of the mnemonics used. That is, the effects obtained may have been the result of mere retrieval practice, regardless of the quality of initial questioning. In Study III these factors were disentangled. The report everything mnemonic technique (i.e. eliciting
more complete accounts) was compared with the spatial questions (i.e. eliciting less detailed statements) to examine how these types of questioning used in the immediate interviews affected the delayed statements of truth tellers and liars.

4.1.1 Delay and deception detection

Engaging in a high-quality (i.e., complete and accurate) initial recall attempt can be a protective factor to prevent memory decay (Bornstein et al., 1998; Hope et al., 2014; Pansky & Nemets, 2012). However, incomplete immediate accounts can negatively affect not only memory (Hope et al., 2014; Macleod, 2002; Shaw et al., 1995), but also credibility assessment. First, deception research has shown that richness of detail in a statement is one of the most diagnostic cues to credibility, with truthful statements typically containing more details than deceptive ones (DePaulo et al., 2003; Vrij, 2008, 2015). Second, interviewers often associate lack of detail with poor credibility (Akehurst et al., 1996; Bogaard et al., 2016; Strömwall & Granhag, 2003). Although the role of type of questioning in human memory has been extensively researched (Memon, Meissner, & Fraser, 2010), it is as yet unknown how it affects discrimination between truth tellers and liars in a repeated interviewing (immediately and after a delay) context.

If the passage of time can undermine discrimination between truth tellers and liars (Harvey et al., 2017), in this study the focus was to discover whether immediate interviewing could assist in later distinguishing truthful from deceptive accounts after the delay. In addition, the effectiveness of two immediate interviewing strategies (complete and less complete) to detect deception in the delayed accounts was compared. In the current study two immediate types of interview were compared, i) report everything (promoting complete retrieval) and ii) spatial open-ended questions (promoting selective retrieval), and examined how these questioning types affected the delayed reports of truth tellers and liars.
The report everything instruction was chosen because it is considered best practice in investigative interviewing (Fisher & Geiselman, 1992; Milne & Bull, 1999; Hope et al., 2011). The report everything instruction is a mnemonic technique that prompts interviewees to disclose all information they remember, whether it seems trivial or not (Fisher & Geiselman, 2010). This technique is valuable because details that an interviewee considers to be irrelevant may be important for the investigation, and recall of some details may activate memories of other relevant details (Fisher & Geiselman, 1992).

Regarding spatial open-ended questioning, spatial details are important because they give valuable knowledge about directions of movement, locations of people or objects, or the layout of crime scene (Hope et al., 2011). However, when the interviewer puts emphasis only on questioning about one aspect of the event (spatial information), but neglects to ask questions about the other aspects (e.g., descriptions about actions of people during the crime), there is a risk to elicit less complete statements at the initial interview and after a delay (Gabbert et al., 2016). Furthermore, spatial questions, specifically, were chosen in Study III for the sake of coherence within this whole thesis of research. That is, in Study II, the effects of sketch mnemonic focused on elicitation of spatial information and so I aimed to keep this consistent in the current study.

It is important to note that in the current study, both interview types involved initial retrieval practice (a term also known as ‘testing effect’), an act of recalling information to induce better retention in memory (Roediger & Butler, 2011; Roediger & Karpicke, 2006). Also, research in human memory has shown that activation of some information produces facilitative effects on later retrieval of related, but not initially reported information (Chan, McDermott, & Roediger, 2006). Although it was not intended to test how immediate reporting of some details enhanced the delayed reporting of associated, but previously not mentioned details, it was speculated that the less complete initial interviewing (spatial
questions) would produce fewer associative links, and, as a result, less detailed accounts than the more complete interviewing (report everything mnemonic). Therefore, the difference between truth tellers and liars is likely to be reduced with the interview type eliciting less complete truthful accounts.

4.1.2 Hypotheses

It was predicted that truth tellers would report more visual, spatial, temporal and action details than liars after a delay in the report everything condition (Hypothesis 1). Compared to liars, truth tellers would report more visual and spatial details and an equal amount of temporal and action details in the delayed statements of the spatial questions condition (Hypothesis 2). As truth tellers should benefit more from the report everything mnemonic technique than from the spatial questioning interview, an interaction was expected: differences between truth tellers and liars would be larger in the report everything than the spatial questions condition in the delayed statements (Hypothesis 3). Truth tellers, but not liars, would show patterns indicative of genuine memory decay (Hypothesis 4). Truth tellers would produce more reminiscences and omissions than liars after a delay in both the report everything and spatial questions initial reporting conditions (Hypothesis 5).

4.2 Method

4.2.1 Participants

A total of 81 volunteers took part in the study. This study had enough power (Cohen, 1992) of 0.93 to obtain medium effect sizes. The mean age of participants was 31.81 years ($SD = 10.12$), 72.8% were female and 27.2% were male. Participants were recruited via posters, flyers, and a volunteer database. Fluent English speakers were required to take part in
the study because verbal content of the statement was examined. The majority of participants were not English native speakers, therefore, they were asked to rate their fluency in language before the beginning of the experiment. One person was excluded because of language issues (e.g. the participant experienced difficulties in understanding the instructions and expressing him/herself during the interview). Thus, the final sample included 80 volunteers. They were awarded with shopping vouchers worth 100 SEK (approx. €10) after they completed the experiment. In addition, all participants were entered into a draw to win a single prize worth 1000 SEK.

This experiment was conducted in a different country from Studies I and II, therefore, the possibility of duplication of participants was highly unlikely.

4.2.2 Design

A 2 (Veracity: Truthful vs deceptive) × 2 (Initial Interview: Report everything vs spatial questions) × 2 (Time of Interview: Immediate vs delayed) experimental design was used with Veracity and Initial Retrieval as between-subject factors and Time of Interview as within-subjects factor. Visual, spatial, temporal, and action details were the dependent variables for the type of details analysis; reminiscences, repetitions, and omissions were the dependent variables for the consistency analysis. Participants were randomly assigned to the Veracity and Initial Interview conditions (report everything: truth tellers, n = 18; liars, n = 20; spatial questions: truth tellers, n = 22; liars, n = 20). All participants were interviewed twice, immediately after the stimulus event and two weeks later. Not all participants were available

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5 English proficiency level scale was adapted from the London School of English (2018). The scale consisted of six categories: i) Elementary (“I can say and understand a few things in English”); ii) Pre-intermediate (“I can communicate simply and understand in familiar situations, but only with some difficulty”); iii) Intermediate (“I can speak and understand reasonably well and can use basic tenses, but have problems with more complex grammar and vocabulary”); iv) Upper-intermediate (“I speak and understand well, but still make mistakes and fail to make myself understood occasionally”); v) Advanced (“I speak and understand very well, but sometimes have problems with familiar situations and vocabulary”); and vi) Very advanced (“I speak and understand English completely fluently”). Participants classified themselves as Intermediate 6.3%, Upper-intermediate 25%, Advanced 37.5%, and Very advanced 31.3%.
exactly 14 days after the first interview, therefore, the delay time for the second interview varied between 8 and 27 days ($M = 14.66$, $SD = 3.67$). The delay time for the majority of participants (45%) was 14 days.

4.2.3 Materials

**Stimulus event.** Same as in Studies I and II, a filmed event depicting a simulated break-in was used.

4.2.4 Procedure

**Pre-interview phase.** In the beginning, participants were instructed to consider that they were in the video described above, and they were following the other person in that video. They were also given the instruction to take the role of intelligence officer working undercover with another officer who was seen in the video. They were told their task was to break into an apartment with that officer and secure important information for intelligence gathering. All participants were instructed that the apartment they broke into was a staff room of a community centre. This special task was recorded from the perspective of the person who followed the other man throughout the break-in. Therefore, the participants were instructed ‘to follow’ the intelligence officer seen in the recording.

After watching the break-in video, participants were randomly assigned to the veracity conditions. Truth tellers were informed that the break-in was successful and they would be interviewed by a fellow agent to continue the investigation. They were asked to tell the truth during the interview about 1) the interior of the staff room in the video, and 2) what they took from there. Liars were also informed that the break-in was successful. However, they were instructed that they would be interviewed by an agent of a hostile agency and that their task was to create a convincing cover story. If the hostile officer came to know about the
exact place they broke into and what was taken from there, the entire investigation would be in danger. Therefore, liars were instructed to fabricate details about 1) the interior of the staff room in the video, and 2) what they took from there.

To increase participants’ motivation to be convincing in the interviews, they were told that if they were convincing during the interviews, they would receive a full 100 SEK reward and be entered in the draw to win 1000 SEK worth prize. If they were not convincing enough, i.e. the interviewer thought they did not report everything they remember, they were told that they would only receive 50 SEK, would be excluded from the draw, and would have to write a full statement of what happened in the video.

After the veracity instructions, participants were offered unlimited time to prepare for the interview. After preparation, a pre-interview questionnaire was administered. Participants were requested to respond truthfully. In the questionnaire participants were asked to rate on 7-point scales their preparation for the interview. They were asked to indicate how well they were prepared (1 = very poor, 7 = very good); and how sufficient (1 = insufficient, 7 = sufficient) and complete (1 = incomplete, 7 = complete) their preparation was. These three preparation items were clustered into one variable, Preparation quality (Cronbach’s alpha was .95 for the immediate and .90 for the delayed interviews). The pre-interview questionnaire also included questions about their levels of stress and motivation, and subjective confidence in being convincing in the upcoming interview. These answers were also rated on 7-point scales (1 = not at all, 7 = totally).

**Interviews.** The participants were questioned by an interviewer who was blind to the aims of the study, stimulus material, and veracity conditions.

In the immediate interview of the report everything condition, truth tellers and liars were asked to provide a free recall, i.e. to report everything they could remember from the break-in, including descriptions of objects and locations, the sequences of actions, and
information about any people that were involved. They were also asked to not guess about details that they could not remember.

In the immediate interview of the spatial questions condition, truth tellers and liars were not invited to give a free recall, but were asked five open-ended questions related to spatial characteristics of the break-in instead. The questions asked by the interviewer were: i) *Describe the corridor of the apartment you broke into*; ii) *Describe the interior of the staff room*; iii) *Describe distinguishing features of the staff room*; iv) *Describe the outside area of the building you entered into*; and v) *Which items were taken and describe where they were taken from*?

After the immediate interview, the first session of the experiment was completed. All participants were told that the second part of the experiment would be after two weeks. When participants returned for the second interview, interviewees in all conditions were asked to provide a free recall, *report everything*.

**Post-interview phase.** Participants completed a post-interview questionnaire after the delayed interview only. As with the pre-interview questionnaire, truth tellers and liars were requested to be honest with their responses. The post-interview questionnaire included questions about what they thought the likelihood was of i) receiving the 100 SEK, and ii) having to write a statement (1 = *not at all*, 7 = *very likely*). As previous research has found that active repetition of learned information can prevent memory decline (Bornstein et al., 1998), participants were also asked to estimate how many times they had tried to remember the break-in (truth tellers)/cover story (liars) between the two interviews. Lastly, participants were asked about the extent to which they i) told the truth, and ii) lied during the interview. Participants indicated on 11-point Likert scales ranging from 0% (not at all) to 100% (totally). These two questions were asked on both occasions to assess the truthfulness in both the immediate and delayed accounts.
After completing the post-interview questionnaire, all participants were thanked, fully debriefed, and rewarded with a shopping voucher worth 100 SEK for participation in the experiment. After full data collection, one participant was randomly selected as the lottery winner.

Noteworthy, after the immediate interview and, again, after the completion of the whole study each participant was explicitly instructed to keep the content of the experiment confidential.

4.2.5 Coding

**Verbal details.** Interviews were audio recorded and then transcribed verbatim. All statements were coded for the details provided in both the immediate and delayed accounts. Each detail was counted once per interview. As in previous studies of this thesis, *visual, spatial, temporal, and action* details were coded.

The first coder, the author of this study, coded all transcripts. The second coder, blind to the hypotheses, stimulus event, and veracity of the statements, coded a random sample of 16 (20.0%) interview scripts to assess reliability. Inter-rater reliabilities between the two coders for the frequency of detail in both (immediate and delayed) statements were measured via intraclass correlation coefficients (ICC). The ICC revealed excellent inter-rater values: .95, CI [.22,.99] for visual details; .96, CI [.76,.99] for spatial details; .97, CI [.85,.99] for temporal details; and .99, CI [.97,1.00] for action details.

**Between-statement consistency.** The coded details were used for a consistency analysis. The total amount of details (visual, spatial, temporal, and action details combined) was examined for consistency in the responses between the immediate and delayed
statements. Again, three consistency measures were analysed: Reminiscences, repetitions, and omissions⁶.

Identically to Study I and II, the coders only coded reminiscences and arithmetic calculations were used to obtain repetitions and omissions.

Again, two coders were used for the consistency coding. The first coder marked all transcripts and the second coder marked a random sample of 15 (18.8%) interview scripts. As before, the second coder was blind to the hypotheses, stimulus event, and veracity of the statements. Inter-rater reliability for reminiscences was examined because that was the only measure coded manually. The analysis revealed excellent ICC of .93, CI [.71,.98] for reminiscences in the delayed vs. immediate reports.

4.3 Results

4.3.1 Manipulation checks

Mixed ANOVAs with Veracity as the between-subjects factor and Time of Interview as the within-subject factor were used for all the manipulation checks. Mean scores, standard deviations and confidence intervals for truth tellers and liars are presented in Table 4.1.

There was a main effect of Veracity condition on self-reported truthfulness. Truth tellers reported that they were more truthful than did the liars during both the immediate, \( F(1, 78) = 257.82, p < .001, d = 3.59 \) and delayed interviews, \( F(1, 78) = 350.77, p < .001, d = 4.19 \), indicating that participants complied with the instructions given. No significant Veracity main effects were found regarding the other manipulation measures, all \( F’s < 2.81 \), all \( p’s > .09 \), see Table 4.1. Although Veracity differences have been found in previous

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⁶ Contradictions, the fourth measure of consistency, did not occur often enough in the reports of truth tellers and liars. One or more contradictions were present only in 22.5% of truthful statements and 32.5% of deceptive statements.
similar studies (Ewens et al., 2016; Vrij et al., 2009), no reason can be identified as to why the absence of a Veracity effect would be detrimental for this experiment.

Table 4.1

Means, standard deviations and confidence intervals for responses to pre-interview and post-interview questionnaires

<table>
<thead>
<tr>
<th>Measure</th>
<th>Truth</th>
<th>Lie</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Extent of truthfulness in the immediate interview*</td>
<td>99.00</td>
<td>3.04</td>
</tr>
<tr>
<td>Extent of truthfulness in the delayed interview*</td>
<td>99.50</td>
<td>2.21</td>
</tr>
<tr>
<td>Preparation time (sec.)</td>
<td>123.35</td>
<td>102.47</td>
</tr>
<tr>
<td>Preparation quality</td>
<td>5.39</td>
<td>1.15</td>
</tr>
<tr>
<td>Stress before the interview</td>
<td>2.65</td>
<td>1.24</td>
</tr>
<tr>
<td>Motivation to convince the interviewer</td>
<td>6.12</td>
<td>1.20</td>
</tr>
<tr>
<td>Confidence to convince the interviewer</td>
<td>5.13</td>
<td>0.84</td>
</tr>
<tr>
<td>Times thought about the event/story</td>
<td>3.37</td>
<td>4.12</td>
</tr>
<tr>
<td>Likelihood to receive 100 SEK</td>
<td>5.33</td>
<td>1.42</td>
</tr>
<tr>
<td>Likelihood to write a statement</td>
<td>2.90</td>
<td>1.75</td>
</tr>
</tbody>
</table>

* p < .001

The Time of Interview main effect was significant for Preparation time, \( F(1, 73) = 11.73, p = .001, d = 0.34 \). Participants took longer to prepare before the immediate interview
(M = 165.48, SD = 148.07, 95% CI [132.72,199.32]) than before the delayed interview (M = 121.11, SD = 127.38, 95% CI [94.86,147.36]). This makes sense because participants were less familiar with the settings before the immediate interview than before the delayed interview. The other Time of Interview main effects were not significant, all F’s < 3.12, all p’s > .081.

A significant Veracity × Time of Interview interaction effect emerged for Motivation, F(1, 74) = 6.31, p = .014, η_p^2 = .08. Truth tellers (M = 6.30, SD = 0.94, 95% CI [5.93,6.67]) expressed higher levels of motivation than liars (M = 5.72, SD = 1.37, 95% CI [5.34,6.11]) before the immediate interview, t(74) = 2.17, p = .033, d = 0.49. However, the means show that participants in both groups were highly motivated as their scores were at the upper end of the motivation scale. The motivation level of truth tellers and liars did not differ before the delayed interview, t(74) = 0.18, p = .861, d = 0.04. The Veracity × Time of Interview interaction effect was also significant for Preparation time, F(1, 73) = 6.92, p = .010, η_p^2 = .09. Liars (M = 201.54, SD = 150.84, 95% CI [154.14,248.94]) took longer than truth tellers to prepare before the immediate interview (M = 130.50, SD = 138.40, 95% CI [83.73,177.27]), t(73) = 2.13, p = .037, d = 0.49, whereas the Preparation time for truth tellers and liars was similar before the delayed interview, t(73) = 0.04, p = .971, d = 0.01. Again, this may be due to liars being less familiar with the settings before the immediate interview than before the delayed interview. All other Veracity × Time of Interview interaction effects were not significant, all F’s < 3.29, p’s > .075.

Finally, one-way ANOVAs with Veracity as the sole factor and (i) Times thought about the event/story before the second interview, (ii) Incentive (likelihood of getting 100 SEK), and iii) Likelihood to write a statement as dependent variables revealed no significant main effects for Veracity, F’s < 2.34, p’s > .131. In the three latter analyses Interview was not included as a factor as the questions referred to the two interviews combined. Again, although
previous research showed differences between truth tellers and liars regarding these variables (Ewens et al., 2016; Vrij et al., 2009), there is no clear theoretical reason as to why the absence of a Veracity effect would be detrimental.

4.3.2 The effects of the immediate reports on the number of details in the delayed accounts (Hypotheses 1, 2, and 3)

To examine whether the number of reported details differed between truthful and deceptive statements in the delayed interview, a MANOVA with Veracity and Initial Interview as the between-subjects factors and visual, spatial, temporal, and action details as the dependent variables revealed a significant multivariate Veracity main effect, $F(4, 73) = 25.82, p < .001, \eta^2_p = .59$. Univariate Veracity main effects were significant for visual, $F(1, 76) = 55.66, p < .001, \eta^2_p = .42$, spatial, $F(1, 76) = 53.14, p < .001, \eta^2_p = .41$, temporal, $F(1, 76) = 69.05, p < .001, \eta^2_p = .48$, and action details, $F(1, 76) = 90.09, p < .001, \eta^2_p = .54$.

There was a significant multivariate Initial Interview main effect, $F(4, 73) = 6.73, p < .001, \eta^2_p = .27$. At a univariate level, the Initial Interview main effects were significant for spatial, $F(1, 76) = 11.67, p = .001, \eta^2_p = .13$, temporal, $F(1, 76) = 9.79, p = .002, \eta^2_p = .11$, and action details, $F(1, 76) = 24.66, p < .001, \eta^2_p = .25$, but not significant for visual details, $F(1, 76) = 16.20, p = .059, \eta^2_p = .05$. A multivariate Veracity × Initial Interview interaction effect was not significant, $F(4, 73) = 4.31, p = .222, \eta^2_p = .07$. At a univariate level, the interaction effects were significant for visual, $F(4, 76) = 4.31, p = .041, \eta^2_p = .05$, and action details, $F(4, 76) = 4.88, p = .030, \eta^2_p = .06$ (see Figure 4.1). The interaction effects were not significant.
for spatial, $F(4, 76) = 3.14, p = .080, \eta^2_p = .04$, and temporal details, $F(4, 76) = 1.38, p = .244, \eta^2_p = .02$.

Table 4.2 shows that truth tellers reported significantly more visual, spatial, temporal, and action details than liars in the report everything condition after the delay. Hypothesis 1 was supported. Truth tellers also reported significantly more visual, spatial, temporal, and action details than liars in the spatial questions condition after the delay. Hypothesis 2 was partially supported because it was predicted that truth tellers would only report more visual and spatial details than liars in the spatial questions condition after the delay.

Figure 4.1. Illustration of the veracity and type of interview interaction effect in the delayed interview.

To examine the hypothesis concerning differences in reporting the number of details between truth tellers and liars across initial interview conditions in the delayed interviews, simple effects analyses were conducted. Table 4.2 shows that truth tellers reported significantly more visual, spatial, temporal, and action details than liars in the report everything condition after the delay. Hypothesis 1 was supported. Truth tellers also reported significantly more visual, spatial, temporal, and action details than liars in the spatial questions condition after the delay. Hypothesis 2 was partially supported because it was predicted that truth tellers would only report more visual and spatial details than liars in the spatial questions condition after the delay.
Table 4.2

*Details in the delayed interview as a function of veracity and initial retrieval condition*

<table>
<thead>
<tr>
<th>Detail</th>
<th>Truth</th>
<th>Lie</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Report everything</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual</td>
<td>65.78</td>
<td>24.36</td>
</tr>
<tr>
<td>Spatial</td>
<td>33.11</td>
<td>15.36</td>
</tr>
<tr>
<td>Temporal</td>
<td>12.78</td>
<td>6.18</td>
</tr>
<tr>
<td>Action</td>
<td>37.22</td>
<td>14.57</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial questions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual</td>
<td>50.36</td>
<td>16.24</td>
</tr>
<tr>
<td>Spatial</td>
<td>20.82</td>
<td>10.17</td>
</tr>
<tr>
<td>Temporal</td>
<td>8.82</td>
<td>4.16</td>
</tr>
<tr>
<td>Action</td>
<td>22.00</td>
<td>7.63</td>
</tr>
</tbody>
</table>

In Hypothesis 3, it was predicted that the difference between truthful and deceptive reports will be larger in the report everything condition than in the spatial questions condition during the delayed interviews. Although the multivariate Veracity × Initial Interview interaction effect was not significant, at a univariate level interactions were significant for visual and action details. A *p*-value provides information about the statistical relevance, but not about the practical importance of an effect (Fritz, Morris, & Richler, 2012; du Prel, Hommel, Röhrig, & Blettner, 2009). In this article, the practical relevance of the effect was of the interest and *d*-values are indicators of practical relevance (Fritz et al., 2012).

In the report everything condition, the effect sizes were 1.96, 95% CI [1.18,2.73] for visual, and 2.16, 95% CI [1.35,2.95] for action details. In the spatial questions condition, the effect sizes were 1.30, 95% CI [0.61,2.93] for visual, and 2.09, 95% CI [1.30,2.79]) for action details. Although the effect sizes were large in both initial reporting conditions, they were
somewhat lower for visual details in the spatial questions than in the report everything condition, indicating partial support for Hypothesis 3.

4.3.3 Difference between the immediate and delayed interviews (Hypothesis 4)

To examine how the amount of details changed between the immediate and delayed interviews in truthful and deceptive reports, a MANOVA with Veracity and Initial Interview as the between-subjects factors, and Time of Interview as the within-subject factor, and visual, spatial, temporal, and action details as the dependent variables revealed a significant multivariate Veracity × Initial Interview x Time of Interview interaction effect, $F(4, 73) = 4.89, p = .001, \eta_p^2 = .21$. At a univariate level, the interaction effects were significant for temporal, $F(4, 76) = 11.51, p = .001, \eta_p^2 = .13$, and action details, $F(4, 76) = 12.74, p = .001, \eta_p^2 = .06$. The interaction effects were not significant for visual, $F(4, 76) = 0.33, p = .570, \eta_p^2 = .004$, or spatial details, $F(4, 76) = 1.11, p = .296, \eta_p^2 = .01$.

Simple effects analysis revealed that in the spatial questions condition, truth tellers showed a significant decline between the immediate and delayed interviews in reporting visual details, $F(1, 76) = 12.67, p = .001, d = 0.73$. However, truth tellers reported fewer spatial, $F(1, 76) = 4.61, p = .035, d = 0.47$, temporal, $F(1, 76) = 17.09, p < .001, d = 0.71$, and action details, $F(1, 76) = 31.73, p < .001, d = 1.03$ in the immediate than in the delayed interviews. In the spatial questions condition, liars showed a significant decline between the immediate and delayed interviews in reporting visual details, $F(1, 76) = 20.65, p < .001, d = 0.91$. Liars showed no significant decline in reporting spatial, $F(1, 76) = 0.73, p = .397, d = 0.25, d = 0.21$, temporal, $F(1, 76) = 0.52, p = .472, d = 0.22$, or action details, $F(1, 76) = 0.15, p = .702, d = 0.14$.

To test Hypothesis 4 directly, the statements only in the report everything condition were analysed. The examination of the number of details in the spatial questions condition is
not relevant because in this condition different types of question were used in the immediate and delayed interviews. Therefore, reporting differences between the statements could emerge as a result of different questioning rather than as a direct result of delay.

Simple effects analysis revealed that truth tellers showed a significant decline between the immediate and delayed interviews in reporting temporal details, $F(1, 76) = 9.96, p = .002, d = 0.45$, and action details, $F(1, 76) = 5.60, p = .021, d = 0.25$. Truth tellers showed no difference in reporting visual, $F(1, 76) = 0.37, p = .546, d = 0.07$, and spatial details, $F(1, 76) = 0.10, p = .749, d = 0.03$. Liars showed no significant decline in reporting visual, $F(1, 76) = 1.36, p = .247, d = 0.27$, spatial, $F(1, 76) = 1.27, p = .264, d = 0.21$, temporal, $F(1, 76) = 0.07, p = .797, d = 0.03$, or action details, $F(1, 76) = 0.11, p = .746, d = 0.07$. Thus, Hypothesis 4 was supported.

4.3.4 Consistency between the immediate and delayed interviews (Hypothesis 5)

An ANCOVA with Veracity and Initial Interview as the between-subject factors was conducted with reminiscences as the dependent variable and total detail at immediate interview as a covariate. The reason for including this covariate was that the number of reminiscences in the delayed interview depends on the amount of detail provided in the immediate interview. That is, the more details provided in the immediate account, the less opportunity to add new details in the delayed account. There was a significant main effect for Veracity, $F(1, 75) = 13.48, p < .001, \eta^2_p = .15$. Truth tellers reported more reminiscence details ($M = 29.86, SD = 15.81, 95\% \text{ CI}[24.85, 34.87]$) than liars ($M = 15.55, SD = 15.50, 95\% \text{ CI}[10.67, 20.42]$) in the delayed interview. The Initial Interview main effect was also significant, $F(1, 75) = 4.83, p = .031, \eta^2_p = .06$. Participants reported more reminiscent details in the spatial questions ($M = 26.09, SD = 14.13, 95\% \text{ CI}[21.97, 30.66]$) than in the report everything condition ($M = 19.09, SD = 14.30, 95\% \text{ CI}[14.48, 23.70]$). The Veracity $\times$ Initial Interview interaction was also significant, $F(1, 75) = 5.24, p = .027, \eta^2_p = .06$.
Interview interaction effect was significant, $F(1, 75) = 4.17, p = .045, \eta_p^2 = .05$. Planned comparisons revealed that truth tellers and liars reported a similar number of reminiscences in the report everything condition, but that truth tellers reported more reminiscences than liars in the spatial questions condition, see Table 4.3. The reminiscent detail results partially support Hypothesis 5.

Table 4.3

*Between-statement consistency characteristics as a function of veracity and initial interview condition*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Truth</th>
<th>Lie</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>95% CI</td>
<td>M</td>
<td>SD</td>
<td>95% CI</td>
</tr>
<tr>
<td>Report everything</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Reminiscence   | 22.91     | 17.10     | 14.88,30.94 | 15.27    | 14.58     | 8.78,21.77 | 1.80     | .183     | 0.48
| Repetition     | 81.85     | 18.07     | 73.36,90.33 | 62.32    | 13.77     | 55.46,69.17 | 10.58    | **.002** | 1.22
| Omission       | 11.41     | 18.07     | 2.92,19.89 | 30.93    | 13.77     | 24.08,37.79 | 10.58    | **.002** | 1.22
| Spatial questions |           |           |          |           |           |          |          |          |          |
| Reminiscence   | 36.81     | 13.70     | 31.00,42.62 | 15.82    | 14.67     | 9.29,22.34 | 22.63    | **<.001** | 1.48
| Repetition     | 63.31     | 14.45     | 57.17,69.45 | 51.63    | 15.47     | 44.75,58.52 | 6.28     | **.014** | 0.78
| Omission       | 29.94     | 14.45     | 23.80,36.08 | 41.62    | 15.47     | 34.73,48.50 | 6.28     | **.014** | 0.78

The same ANCOVA with repetitions as the dependent variable and total detail at immediate interview as a covariate revealed a significant main effect for Veracity, $F(1, 75) = 14.36, p < .001, \eta_p^2 = .16$. Truth tellers reported more repetitions ($M = 72.58, SD = 16.76, 95\% CI [67.29,77.86]$) than liars ($M = 56.98, SD = 16.32, 95\% CI [51.83,62.12]$) in the delayed interview. The Initial Interview main effect was also significant, $F(1, 75) = 17.74, p$

---

7 Veracity effects without entering Total detail at immediate interview as a covariate are presented in Table 4.4
< .001. \( \eta^2_p = .19 \). Participants reported more repetitions in the report everything \((M = 72.08, SD = 15.04, 95\% \text{ CI}[67.21, 76.95])\) than in the spatial questions condition \((M = 57.47, SD = 14.91, 95\% \text{ CI}[52.89, 62.05])\). The Veracity \times Initial Interview interaction effect was not significant, \(F(1, 75) = 1.29, p = .259, \eta^2_p = .02\). Planned comparisons revealed that truth tellers reported more repetitions than liars in both initial reporting conditions, see Table 4.3. The repetition results do not support Hypothesis 5.

Table 4.4

*Between-statement consistency characteristics as a function of veracity and initial interview condition (without the addition of covariates)*

<table>
<thead>
<tr>
<th>Measure</th>
<th>Truth</th>
<th>Lie</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(M)</td>
<td>(SD)</td>
</tr>
<tr>
<td>Report everything</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reminiscence</td>
<td>25.22</td>
<td>16.21</td>
</tr>
<tr>
<td>Repetition</td>
<td>123.67</td>
<td>50.00</td>
</tr>
<tr>
<td>Omission</td>
<td>35.17</td>
<td>28.70</td>
</tr>
<tr>
<td>Spatial questions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reminiscence</td>
<td>36.91</td>
<td>17.87</td>
</tr>
<tr>
<td>Repetition</td>
<td>65.09</td>
<td>21.78</td>
</tr>
<tr>
<td>Omission</td>
<td>30.96</td>
<td>15.60</td>
</tr>
</tbody>
</table>

The same ANCOVA with omissions as the dependent variable and total detail at immediate interview as a covariate revealed a significant main effect for Veracity, \(F(1, 75) = 14.36, p < .001, \eta^2_p = .16\). Truth tellers omitted less details \((M = 20.67, SD = 16.76, 95\% \text{ CI}[15.39,25.96])\) than liars \((M = 36.28, SD = 16.32, 95\% \text{ CI}[31.13,41.42])\) in the delayed interview. The Initial Interview main effect was also significant, \(F(1, 75) = 17.74, p < .001, \eta^2_p = .19\). Participants made fewer omissions in the report everything \((M = 21.17, SD =\)
15.04, 95% CI [16.30, 26.04]) than in the spatial questions condition ($M = 35.78, SD = 14.91, 95% CI [31.20, 40.36])]. The Veracity \times Initial Interview interaction effect was not significant, $F(1, 75) = 1.29, p = .259, \eta^2_p = .02$. In support of Hypothesis 5, planned comparisons revealed that truth tellers made fewer omissions than liars in both initial reporting conditions, see Table 4.3. These consistency results thus partially support Hypothesis 5.

### 4.3.5 Exploratory analysis of the number of details in the immediate accounts

Although the hypotheses focused only on the delayed accounts, it was also considered important to examine the effect of the two interview techniques on the immediate statements made by truth tellers and liars.

![Figure 4.2. Illustration of the veracity and type of interview interaction effect in the immediate interview](image)

A MANOVA with Veracity and Initial Interview as the between-subjects factors and visual, spatial, temporal, and action details as the dependent variables revealed a significant multivariate effect for Veracity, $F(4, 73) = 15.08, p < .001, \eta^2_p = .45$. Univariate Veracity main effects were significant for visual, $F(1, 76) = 30.20, p < .001, \eta^2_p = .28$, spatial, $F(1, 76) = 32.85, p < .001, \eta^2_p = .30$, temporal, $F(1, 76) = 54.60, p < .001, \eta^2_p = .42$, and action
details, \( F(1, 76) = 50.88, p < .001, \eta^2_p = .40 \). There was a significant multivariate Initial Interview effect, \( F(4, 73) = 23.64, p < .001, \eta^2_p = .56 \).

Table 4.5

*Details in the immediate interview as a function of veracity and initial retrieval condition*

<table>
<thead>
<tr>
<th>Detail</th>
<th>Truth M</th>
<th>SD</th>
<th>95% CI</th>
<th>Lie M</th>
<th>SD</th>
<th>95% CI</th>
<th>F</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report everything</td>
<td>67.72</td>
<td>29.81</td>
<td>58.03,77.41</td>
<td>32.55</td>
<td>15.30</td>
<td>23.36,41.74</td>
<td>27.51</td>
<td>.001</td>
<td>1.48</td>
</tr>
<tr>
<td>Spatial</td>
<td>33.67</td>
<td>18.69</td>
<td>28.47,38.87</td>
<td>13.50</td>
<td>9.30</td>
<td>8.57,18.43</td>
<td>31.38</td>
<td>.001</td>
<td>1.37</td>
</tr>
<tr>
<td>Temporal</td>
<td>16.00</td>
<td>8.01</td>
<td>13.79,18.22</td>
<td>3.80</td>
<td>2.55</td>
<td>1.70,5.90</td>
<td>63.18</td>
<td>.001</td>
<td>2.05</td>
</tr>
<tr>
<td>Action</td>
<td>41.44</td>
<td>18.61</td>
<td>36.23,46.66</td>
<td>12.95</td>
<td>7.45</td>
<td>8.01,17.89</td>
<td>62.41</td>
<td>.001</td>
<td>2.01</td>
</tr>
</tbody>
</table>

**Spatial questions**

<table>
<thead>
<tr>
<th>Detail</th>
<th>Truth M</th>
<th>SD</th>
<th>95% CI</th>
<th>Lie M</th>
<th>SD</th>
<th>95% CI</th>
<th>F</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual</td>
<td>60.68</td>
<td>15.10</td>
<td>51.92,69.45</td>
<td>45.00</td>
<td>20.55</td>
<td>35.81,54.19</td>
<td>6.05</td>
<td>.016</td>
<td>0.87</td>
</tr>
<tr>
<td>Spatial</td>
<td>17.45</td>
<td>6.28</td>
<td>12.75,22.16</td>
<td>9.15</td>
<td>6.95</td>
<td>4.22,14.09</td>
<td>5.88</td>
<td>.018</td>
<td>1.25</td>
</tr>
<tr>
<td>Temporal</td>
<td>5.00</td>
<td>4.08</td>
<td>2.99,7.01</td>
<td>1.55</td>
<td>2.64</td>
<td>0.00,3.65</td>
<td>5.59</td>
<td>.021</td>
<td>1.00</td>
</tr>
<tr>
<td>Action</td>
<td>12.91</td>
<td>8.61</td>
<td>8.20,17.62</td>
<td>5.90</td>
<td>6.74</td>
<td>0.96,10.84</td>
<td>4.18</td>
<td>.044</td>
<td>0.91</td>
</tr>
</tbody>
</table>

At a univariate level, the Initial Interview main effects were significant for spatial, \( F(4, 76) = 17.13, p < .001, \eta^2_p = .18 \), temporal, \( F(4, 76) = 39.14, p < .001, \eta^2_p = .34 \), and action details, \( F(4, 76) = 51.11, p < .001, \eta^2_p = .40 \). The univariate Initial Interview main effect was not significant for visual details, \( F(4, 76) = 0.34, p = .561, \eta^2_p = .004 \). A multivariate Veracity × Initial Interview interaction effect was also significant, \( F(4, 73) = 5.74, p < .001, \eta^2_p = .24 \). At a univariate level, the interaction effects were significant for visual, \( F(4, 76) = 4.44, p = .038, \eta^2_p = .06 \), spatial, \( F(4, 76) = 5.70, p = .019, \eta^2_p = .07 \), temporal, \( F(4, 76) = 17.07, p < .001, \eta^2_p = .18 \), and action details, \( F(4, 76) = 18.63, p < .001, \eta^2_p = .20 \) (see Figure 4.2).

The interaction effects are more informative than the two main effect components results. The immediate accounts results suggest that the effects were somewhat larger for
visual, spatial, temporal, and action details in the report everything than in the spatial questions condition, see Table 4.5.

4.4 Discussion

The current study examined the impact of an immediate reporting of information (report everything vs. spatial questions) on the delayed accounts of truth tellers and liars. As predicted, truth tellers reported more visual, spatial, temporal, and action details after the delay than liars, when asked to report everything they remembered in the initial interview. Since Harvey et al. (2017) found no difference between truth tellers and liars after a delay when interviewed only once, this finding suggests that truth tellers benefited from the initial memory enhancement. That is, an extensive immediate retrieval attempt (report everything) could increase activation levels of details during the delayed recall (Anderson, 1983). Thus, large amounts of visual, spatial, temporal, and action details could be accessible for truth tellers when they were interviewed after a delay. Liars reported fewer of these details than truth tellers because they had to manage the output of the amount of information (Granhag & Hartwig, 2008). This is a common strategy used by liars because revealing too many details of the event increases the risk of providing investigators with new leads (Vrij, 2008).

Truth tellers also reported more visual, spatial, temporal, and action details than liars in the delayed accounts, when asked only spatial questions in the immediate interviews. A possible explanation for this finding derives from activation theory of memory (Anderson, 1983). Specifically, truth tellers in the spatial questions condition could concentrate on reporting visual and spatial details because of the nature of the questions in the immediate interview. As these details were associated with the other details in their episodic memory of the break-in, temporal and action details may have been easily accessible in the delayed
interview. Therefore, the difference between truth tellers and liars was not only in reporting visual and spatial details, as predicted, but also in reporting temporal and action details, which was not predicted. Liars reported fewer visual, spatial, temporal, and action details than truth tellers in the spatial questions condition, probably because of the different strategies they employed (Hartwig et al., 2007).

Although truth tellers differed from liars in both initial reporting conditions in the delayed interview, it was expected that using the report everything mnemonic in the immediate interview would magnify these differences. Discrimination was indeed larger for reporting visual details in the report everything than in the spatial questions condition. Truth tellers had a more extensive immediate reporting attempt in the report everything condition. As a result, visual details using this mnemonic could be more accessible in truth tellers’ memories than visual details in the spatial questions condition, which resulted in larger differences between truth tellers and liars in the delayed interviews. This explanation becomes more compelling when considering the number of details reported by truth tellers and liars in the immediate accounts. Results in the exploratory analysis showed that the differences between truth tellers and liars were larger for visual, spatial, temporal, and action details in the report everything than in the spatial questions condition.

In the current study was found that truth tellers showed a decline in reporting temporal, and action details. Perhaps there was no decline found in the amount of visual and spatial details for truth tellers because of extensive immediate retrieval practice that could strengthen their recall after the delay. Liars produced a ‘stability bias’ between the immediate and delayed interviews in visual, spatial, temporal, and action details. Consistent with previous research (Harvey et al., 2017), the findings of the study provided further support for the notion that liars may experience difficulties in understanding the degree to which real memories can change over time.
Regarding the consistency characteristics, truth tellers reported more reminiscences than liars in the spatial, but not in the report everything condition. It seems that when the type of interviewing changed from spatial questions to report everything, truth tellers were able to add more details in the delayed interview. As the statements of truth tellers were less complete when asked spatial questions rather than report everything in the immediate interview, they could have had more opportunities to provide additional details in the delayed accounts. This result is consistent with Hope et al. (2014) where participants provided more reminiscences with an interviewing format that promoted less complete initial accounts.

Truth tellers reported more repetitions than liars after the delay in both initial reporting conditions. Results showed that truth tellers already reported more details than liars in the immediate accounts. Therefore, it seems that for truth tellers, the immediate reporting of the details strengthened their memories of those details to be recalled after the delay.

An interesting result was found in terms of omitted details after the delay. Liars omitted more than truth tellers in the delayed accounts in both initial reporting conditions. As noted above, perhaps truth tellers omitted fewer details than liars after the delay because of the relatively extensive immediate retrieval practice in both conditions. Alternatively, a possible explanation for liars having a larger number of omissions than truth tellers derives from avoidant strategies commonly used by liars in interviews (Granhag, Clemens, & Strömwall, 2009; Hartwig et al., 2007). Specifically, liars are motivated to avoid providing details that could possibly incriminate them, resulting in the “keep the story simple” strategy (Strömwall, Hartwig, & Granhag, 2006). Moreover, liars might have omitted more details than truth tellers in order to avoid the risk of contradicting themselves (Granhag & Strömwall, 1999).

Findings from the current study have important implications from an applied perspective. The results suggest that interviewing techniques eliciting complete accounts
from interviewees at an early stage (e.g. report everything mnemonic) are promising in discriminating truth tellers from liars at later stages of the investigation. Thus, the current study shows that techniques promoting extensive free recall about the event in question are not only beneficial in terms of retrieval performance (Hope et al., 2014; Pescod et al., 2013), but also in detecting deception. A comparison of the $d$-values showed that a report everything mnemonic technique produced larger differences between truth tellers and liars than spatial questions.

This study had a few limitations. First, it involved a relatively small sample size. However, post hoc power analyses showed that this study had acceptable power (Cohen, 1992) for the obtained effect sizes that were statistically significant. Therefore, it can be concluded that the study was not underpowered.

Second, it did not include a control condition, making it impossible to determine whether truth tellers reported more details in the delayed interviews than liars only because of the immediate retrieval practice. However, the results showed that the difference between truth tellers and liars was lower with less complete (spatial) immediate retrieval practice. Therefore, it is difficult to think of a theoretical reason as to why the inclusion of a control group would diminish the positive effects of the immediate report everything instruction on the delayed accounts in terms of deception detection.

However, it is important to note that some important manipulations were not successful (e.g. self-reported stress and confidence levels before the interviews were similar across veracity groups), whereas the cognitive credibility assessment proposes that lying is more mentally demanding than telling the truth (Vrij, 2015). Nevertheless, truth tellers and liars indicated high motivation levels before both interviews, which is a critical requirement to resemble real life settings.
Different statistical analyses from Studies I and II were conducted in this study. Although mixed-factor experimental designs were employed across the three studies, in Studies I and II numerous mixed ANOVAs were conducted and in Study III mixed MANOVAs were conducted to analyse the results. The hypotheses in the first two studies addressed the differences between truth tellers and liars in terms of the amount of specific details reported. Therefore, mixed ANOVAs were carried out separately to examine the effects for different dependent variables (visual, spatial, temporal, and action details). However, in Study III the main focus was a comparison of two types of interviewing to differentiate truth tellers and liars in terms of the amount of multiple details reported. Thus, instead of separate ANOVAs, more generalised MANOVAs were carried out in Study III.

In conclusion, the findings of this study send a straightforward message to practitioners in terms of credibility assessment. It is important to conduct a first interview after an event as soon as possible, and to use a questioning format that enhances complete retrieval from the interviewee at the beginning of the investigation. In the legal system the same individuals tend to be interviewed more than once, and so immediate, high-quality questioning can be helpful during subsequent interviews to discriminate between truthful and deceptive accounts. This recommendation could apply to various settings, including interviews with cooperative witnesses or suspects, or in intelligence-gathering interviews.
Chapter 5: Deception detection in repeated interviews: Mnemonic Techniques and Lie Detection: Accuracy of Truth and Deception Judgements in Repeated Accounts

(Study IV)
Abstract

This study was an examination into whether the use of memory-enhancing techniques (mnemonics) in interviews can be helpful to distinguish truth tellers from liars. In the previous study (Izotovas et al., 2018), it was found that when mnemonic techniques were used in the interview immediately after the event, truth-tellers reported more details than liars in those immediate interviews and again after a delay. Moreover, truth-tellers, but not liars, showed patterns of reporting indicative of genuine memory decay.

In the current experiment, participants ($n = 92$) were asked to read the repeated statements reported by participants in the Izotovas et al.’s (2018) study and decide whether the statements they read were truthful or deceptive. One group of participants (informed condition) received information about the findings of the previous study before reading the statement. The other group received no information before reading the statement (uninformed condition). After participants made veracity judgements, they were asked an open-ended question asking what factors influenced their credibility decision. Although truthful statements were judged more accurately in the informed condition (65.2%) than in the uninformed condition (47.8%), this difference was not significant. In both conditions deceptive statements were detected at chance level (52.2%). Participants who relied on the self-reported diagnostic verbal cues to deceit were not more accurate than participants who self-reported unreliable cues. This could happen because only the minority of participants (27.4%) in both conditions based their decisions on diagnostic cues to truth/deceit.
5.1 Introduction

In investigative interviews questions about the credibility of witnesses or suspects frequently arise (Gran Hag & Strömwall, 2004; Vrij, 2008, 2015). However, studies have shown that both laypeople and professionals are in general poor at detecting lies, with accuracy typically not much better than chance level when assessing speech or behaviour (Bond & DePaulo, 2006). Moreover, accuracy at deception detection is not associated with the factors such as observers’ years of professional experience, individual differences or confidence in the veracity judgements made (Masip, Garrido, & Herrero, 2006; Vrij, 2008). A meta-analysis examined possible reasons for this low accuracy rate (Hartwig & Bond, 2011). The most compelling reason was that cues to deception are typically weak. That is, liars and truth tellers often display similar (non)verbal responses. However, recent research has shown that higher accuracy rates can be achieved when specific interview techniques are used (Hartwig et al., 2014; Vrij et al., 2017; Vrij & Granhag, 2012), because these techniques elicit or enhance speech differences between liars and truth tellers. One of the approaches is Cognitive Credibility Assessment (CCA; Vrij, 2018). With this approach, accuracy rates just above 70% can be obtained (Vrij et al., 2017). One of the elements of the CCA is encouraging interviewees to provide more information (Colwell, Hiscock, & Memon, 2002; Geiselman, 2012; Vrij et al., 2017). This can, amongst other ways, be achieved by using mnemonics (Fisher & Geiselman, 1992). Previous studies have shown that the use of mnemonics may increase the verbal differences between truthful and deceptive statements (Bembibre & Higuera, 2011; Hernández & Alonso-Quecuty, 1997; Vrij et al., 2009), because truth tellers, who are recalling genuinely remembered events, benefit more from such memory enhancement techniques than liars, who are fabricating. Liars may lack the imagination or cognitive resources to report as many (plausible) details as truth tellers, or
may be unwilling to do so out of fear that these additional details give leads to investigators that they can check (Vrij et al., 2017).

In the current study, whether observers would be able to spot these enlarged differences between truth tellers and liars was examined. In Study I of this thesis, the effects of different mnemonic techniques on immediate and delayed statements reported by truth tellers or liars were examined. It was found that truth tellers provided significantly more information than liars, both in the immediate interview, and after a two-week delay (Izotovas et al., 2018). Amongst the three mnemonics tested (context reinstatement, sketching and event-line), the event-line was the most effective mnemonic in discriminating between truthful and deceptive statements, achieving large effect sizes in terms of the amount of different types of detail (visual, spatial, temporal, and action) reported in the immediate (Cohen’s $d$ ranging from 1.08 to 1.47) and delayed statements (Cohen’s $d$ ranging from 0.78 to 1.40).

In addition, truth tellers experienced more of a decline than liars in reporting details when comparing the immediate and delayed interviews in the event-line condition (Izotovas et al., 2018). In other words, truth tellers showed patterns of reporting details indicative of genuine memory decay/forgetting, whereas liars showed patterns of a ‘stability bias’, defined as a metacognitive error to correctly understand the nature of memory decline over time (Kornell & Bjork, 2009).

Previous research has shown that accuracy in detecting deception improves when people rely on the correct verbal cues (Bogaard & Meijer, 2018; Hauch et al., 2016; Mann et al., 2004). In the current study, of particular interest was whether observers’ understanding of the Izotovas et al. (2018) findings was related to their lie detection performance. Therefore, one group of participants were informed about the previous findings and then asked to take this into account when making their veracity judgements in the subsequent lie detection task.
Two hypotheses were tested. First, it was predicted that the accuracy rates in identifying both truth tellers and liars would be higher in the informed group than in the uninformed group. Second, it was predicted that accurate participants would rely more on the diagnostic verbal cues to deceit than inaccurate participants.

5.2 Method

5.2.1 Participants

A total of 92 volunteers participated in the study. The mean age of participants was $M = 21.97$ years ($SD = 6.43$) and 82.6% were female. Participants were recruited via posters, flyers, and the University’s volunteer database. Fluent English speakers were required to take part in the study because their task was to evaluate the verbal content of the statements. Participants were awarded with £5 after they completed the experiment. The experiment was accepted by the Science Faculty Ethics Committee of the University.

The documented lists of the participants who already completed Studies I and II were checked before inviting each volunteer to take part in this experiment. Participants who had taken part in one of the previous studies of this thesis were not eligible to partake in Study IV.

5.2.2 Design

A 2 (Veracity: Truthful interviewee vs deceptive interviewee) X 2 (Instruction: Informed group vs uninformed group) experimental design was used with Veracity and Instruction as between-subjects factors. Dependent variables were participants’ veracity judgements and the answers given to questions in a questionnaire: self-reported level of confidence, and perceived cues that affected their decisions. Participants were randomly
assigned to the Informed (n = 46) and Uninformed (n = 46) groups. They were asked to read the statements reported either by truthful (n = 23) or by deceptive interviewees (n = 23). The allocation to the Veracity condition also occurred randomly.

5.2.3 Stimulus material

Forty six verbatim transcripts (23 truthful, 23 deceptive) obtained from a previous study (Izotovas et al., 2018) were used in the current experiment. In that study participants (n = 143) watched a video-recorded staged break-in to an apartment. They were instructed to tell the truth or lie about the event in the video. Each participant was interviewed twice about the event: Immediately and after a two-week delay. At the beginning of the immediate interview participants were asked to report everything they could remember about the event (free recall phase). After this they were given one of three mnemonics (context reinstatement, sketch, or event-line) and asked to describe the event again (mnemonic phase). In the delayed interview of the previous experiment, participants were asked to provide only a free recall. Only the transcripts of the 46 interviews using the event-line mnemonic were used in the current experiment.

5.2.4 Procedure

Each participant was randomly given one of the 46 set of transcripts. They were informed that they would now read two statements made by one person who might be lying or telling the truth about an incident, a break-in into an apartment. Participants were also notified that the first interview was conducted immediately after the alleged event, and the second interview two weeks later.

Informed group. Participants in the informed group were instructed that i) the amount of detail (e.g., descriptions of people and objects, spatial arrangements, events and
activities) in the statement may be considered an indicator of truthfulness (that is, truth-tellers commonly report more details than liars), and ii) although the statements of truth tellers are usually richer, they tend to show a natural memory decline over time, whereas liars tend to report a similar amount of detail, no matter how much time has passed by since an event. Participants were instructed to take this into account when making their veracity judgements.

**Uninformed group.** The uninformed group was only asked to read two interview transcripts from one interviewee and no instructions about the credibility cues was given.

After reading the two statements, all participants were asked to make a veracity judgement (whether the statements were provided by a truth teller or liar). They were also asked to what extent they thought the statements were truthful/deceptive (1 = *totally deceptive*, 7 = *totally truthful*), and how confident they felt about their decision (1 = *not at all*, 7 = *totally*).

The informed participants only were also asked to rate: i) the extent to which their decision about the credibility of the statements was based on the amount of details in the immediate and the delayed statements (1 = *not at all*, 7 = *totally*), and ii) the extent to which their decision about the credibility of the statements was based on the difference in the amount of information provided in the immediate and the delayed statement (for truth-tellers: decline in details; for liars: similar amount of details) (1 = *not at all*, 7 = *totally*). These two items were used as manipulation checks. Finally, the informed participants were asked in an open-ended question what other factors influenced their credibility decision. The uninformed participants were just asked this latter open-ended question about what factors influenced their credibility decision.
5.2.5 Coding of perceived cues

Participant’s self-reported cues that affected their veracity decisions were classified into categories. The terms for the categories derived from previous deception research (DePaulo et al., 2003; Vredeveldt et al., 2014, Vrij, 2008). The responses of the informed and uninformed groups regarding perceived cues were classified into categories. One coder, blind to veracity condition, made the following classification of the reported cues (some typical examples are provided in brackets): Richness of detail (“Detailed describing and remember colours and places and sequence of rooms”), Lack of detail (“The story was not very detailed with aspects of the area and rooms”), Change of details, contradictions (“He said in the first one there was two phones a Samsung, but this changed to an iPhone”), Coherent order (“Making sure the order was roughly the same”), Incoherent order (“The fact that the events were not in the exact order”), Consistency (“The details were the same the whole way through which made it more convincing”), Omissions (“Admitted not remembering certain things after the time period, such as the card number”), Reminiscences (“Explained seeing notice boards, phones and laptops which were not previously mentioned”), Plausibility (“The statements seemed to be realistic”), Confidence (“The second interview seemed more confident”), Speech errors, hesitations (“His grammar and his stuttering makes him out to be not fully honest about the events”), and responses that could not match to any of the categories were coded as Other (“Personal experience as a witness, having to describe details in a stressful situation”). To measure inter-rater reliability, a second coder was given the list of categories and asked to allocate each response to a category. In total, 77.4% of the responses were classified into the same categories by both coders, showing a satisfactory inter-rater reliability. Discrepancies in coding were identified and resolved between the two coders.
Based on meta-analyses and reviews of deception detection research (DePaulo et al., 2003; Vredeveldt et al., 2014, Vrij, 2008), the perceived cues categories into reliable cues, unreliable cues, and unknown cues to truth/deceit were further classified, see Table 5.1. Note that some of the same cues were classified as either reliable or unreliable depending on participants’ veracity decisions. For example, the cue ‘richness of detail’ was classified as reliable if the decision was made as truthful. However, this cue was treated as unreliable if the decision was made as deceptive, because a large amount of details in a statement is considered as an indication of truthfulness rather than deception (DePaulo et al., 2003; Vrij, 2008).

5.3 Results

5.3.1 Manipulation checks

When making veracity judgements, participants in the informed condition reported to have shown a tendency to rely on the amount of details ($M = 5.52, SD = 1.01$, 95% CI [5.24,5.80]), and decline (for truth-tellers)/stability of details (for liars) between the immediate and delayed accounts ($M = 5.54, SD = 1.11$, 95% CI [5.24,5.85]) when making their veracity judgements (measured on 7-point Likert scales). These results indicate that participants in the informed group followed the instructions given to them about the verbal cues to deceit. Self-reported confidence levels about veracity judgements did not differ between the informed ($M = 4.67, SD = 1.25$, 95% CI [4.33,5.02]), and uninformed groups ($M = 4.85, SD = 1.11$, 95% CI [4.51,5.16]), $t(74) = 0.71$, $p = .483$, $d = 0.15$. 
5.3.2 Accuracy of veracity judgements

The accuracy rates obtained by the informed and uninformed groups were compared. In the informed group, 65.2% of truthful statements were correctly classified compared to 47.8% in the uninformed group. This difference was in the predicted direction, but not statistically significant, $\chi^2 (1) = 1.42, p = .234$. The accuracy rate for deceptive statements was identical in the informed and uninformed groups: 52.2%, $\chi^2 (1) = 0.00, p = .976$. Overall, in the informed group, 58.7% of the statements were correctly classified compared to 50.0% in the uninformed group. Although in the predicted direction, these rates did not differ significantly from each other, $\chi^2 (1) = 0.70, p = .404$. Hence, no support for Hypothesis 1 was found.

To further examine the accuracy of judgements in the informed and uninformed groups, the 7-point scale veracity scales (the extent to which the participants rated the statements to be deceptive/truthful) were analysed. For this purpose, inaccurate truthful and accurate deceptive judgements were converted. For example, if a participant rated a deceptive statement as 7 totally truth, his/her answer was converted into score 1, totally incorrect, and, if a participant rated a deceptive statement as 1 totally lie, the answer was converted into score 7, totally correct. In other words, the higher the score the more correct the participants were in their responses. An independent samples t-test showed that the accuracy rates between the informed group ($M = 4.15, SD = 1.53, 95\% \ CI [3.68, 4.59]$) and uninformed group ($M = 3.98, SD = 1.59, 95\% \ CI [3.53, 4.41]$) did not differ significantly, $t(90) = 0.54, p = .594, d = 0.11$. These results showed no support for Hypothesis 1, although the mean values speak in the predicted direction.
5.3.3 Judgements based on perceived deception cues

The frequencies of reported cues and their classification into reliable, unreliable, and unknown cues to truth/deceit in the informed and uninformed groups are shown in Table 5.1. There was a significant difference in frequencies of reported cues between the groups, $\chi^2(2) = 25.65, p = .007$. In the informed group, speech errors, hesitations, 20.0% (truth and lie decisions combined), were the most frequently reported cue. In the uninformed group, consistency, 26.6% (truth and lie decisions combined), was the most frequently reported cue.

When the rates of both groups and veracity decisions were combined, the distribution of the cues differed from chance, $\chi^2(11) = 70.13, p < .001$, with consistency, 21.0%, speech errors, hesitations, 16.9%, change of details, contradictions, 14.5%, and richness of detail, 14.5%, the most prevalent reported cues.

Table 5.1

*Frequencies of participants in the informed and uninformed groups of self-reported cues to truth/deceit and their reliability.*

<table>
<thead>
<tr>
<th>Perceived cue</th>
<th>Reliability</th>
<th>Informed group</th>
<th>Uninformed group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>% within group</td>
<td>Frequency</td>
<td>% within</td>
</tr>
<tr>
<td>Decision:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Richness of detail</td>
<td>Reliable</td>
<td>3</td>
<td>6.7</td>
<td>9</td>
</tr>
<tr>
<td>Plausibility</td>
<td>Reliable</td>
<td>2</td>
<td>4.4</td>
<td>3</td>
</tr>
<tr>
<td>Reminiscences</td>
<td>Reliable</td>
<td>1</td>
<td>2.2</td>
<td>2</td>
</tr>
<tr>
<td>Incoherent order</td>
<td>Reliable</td>
<td>1</td>
<td>2.2</td>
<td>1</td>
</tr>
</tbody>
</table>

142
<table>
<thead>
<tr>
<th>Category</th>
<th>Type</th>
<th>Reliable</th>
<th>Unreliable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omissions</td>
<td>Reliable</td>
<td>1</td>
<td>2.2</td>
</tr>
<tr>
<td>Consistency</td>
<td>Unreliable</td>
<td>2</td>
<td>4.4</td>
</tr>
<tr>
<td>Speech errors, hesitations</td>
<td>Unreliable</td>
<td>5</td>
<td>11.1</td>
</tr>
<tr>
<td>Coherent order</td>
<td>Unreliable</td>
<td>4</td>
<td>8.9</td>
</tr>
<tr>
<td>Confidence</td>
<td>Unreliable</td>
<td>4</td>
<td>8.9</td>
</tr>
<tr>
<td>Lack of detail</td>
<td>Unreliable</td>
<td>1</td>
<td>2.2</td>
</tr>
<tr>
<td>Change of details, contradictions</td>
<td>Unreliable</td>
<td>1</td>
<td>2.2</td>
</tr>
<tr>
<td>Other</td>
<td>Unknown</td>
<td>3</td>
<td>6.7</td>
</tr>
</tbody>
</table>

**Decision:**

**Lie**

<table>
<thead>
<tr>
<th>Category</th>
<th>Type</th>
<th>Reliable</th>
<th>Unreliable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of detail</td>
<td>Reliable</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Change of details, contradictions</td>
<td>Unreliable</td>
<td>4</td>
<td>8.9</td>
</tr>
<tr>
<td>Speech errors, hesitations</td>
<td>Unreliable</td>
<td>4</td>
<td>8.9</td>
</tr>
<tr>
<td>Reminiscences</td>
<td>Unreliable</td>
<td>2</td>
<td>4.4</td>
</tr>
<tr>
<td>Richness of detail</td>
<td>Unreliable</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Consistency</td>
<td>Unreliable</td>
<td>3</td>
<td>6.7</td>
</tr>
<tr>
<td>Coherent order</td>
<td>Unreliable</td>
<td>1</td>
<td>2.2</td>
</tr>
<tr>
<td>Omissions</td>
<td>Unreliable</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>Unknown</td>
<td>3</td>
<td>6.7</td>
</tr>
</tbody>
</table>
The extent to which the participants based their decisions on reliability of cues were then examined. After creating three categories – reliable cues, unreliable cues and unknown cues – the frequencies between these categories were compared, see Table 5.2. Although the distribution between the informed and uninformed groups differed significantly, $\chi^2(2) = 8.05$, $p < .018$, the majority in both groups reported unreliable cues. When frequencies of both groups were combined, the distribution differed from chance, $\chi^2(2) = 90.79$, $p < .001$, with unreliable cues being the most frequently reported cues across participants.

Table 5.2

*Frequencies of reliability of perceived cues in the informed and uninformed groups*

<table>
<thead>
<tr>
<th>Perceived cues</th>
<th>Informed group</th>
<th></th>
<th>Uninformed group</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
<td>%</td>
<td>Frequency</td>
<td>%</td>
</tr>
<tr>
<td>Reliable cues</td>
<td>8</td>
<td>17.8</td>
<td>19</td>
<td>24.0</td>
<td>27</td>
<td>21.8</td>
</tr>
<tr>
<td>Unreliable cues</td>
<td>31</td>
<td>68.9</td>
<td>59</td>
<td>74.7</td>
<td>90</td>
<td>72.6</td>
</tr>
<tr>
<td>Unknown cues</td>
<td>6</td>
<td>13.3</td>
<td>1</td>
<td>1.3</td>
<td>7</td>
<td>5.6</td>
</tr>
</tbody>
</table>

Table 5.3

*Frequencies of reliability of perceived cues and truth/lie accuracy rates*

<table>
<thead>
<tr>
<th>Perceived cues</th>
<th>Accurate (truth and lie combined)</th>
<th>Inaccurate (truth and lie combined)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
</tr>
<tr>
<td>Reliable cues</td>
<td>17</td>
<td>63.0</td>
</tr>
<tr>
<td>Unreliable cues</td>
<td>45</td>
<td>50.0</td>
</tr>
<tr>
<td>Unknown cues</td>
<td>6</td>
<td>85.7</td>
</tr>
</tbody>
</table>
Finally, whether decisions based on reliable or unreliable cues were related to accuracy in the binary veracity judgements was examined. For this the answers for the uninformed and informed groups were merged and the ‘unknown cues’ category disregarded. The accuracy rates between the two categories reliable and unreliable cues were compared. The results are presented in Table 5.3.

Results showed that participants who mentioned reliable cues were not more accurate than those who mentioned unreliable cues, $\chi^2(1) = 1.40, p = .237$. Thus, Hypothesis 2 was not supported.

5.4 Discussion

In the current study the informed and uninformed participants were not statistically significantly different in their veracity judgements. One possible explanation is that the instruction given to the informed group was not effective to achieve improvements in deception detection accuracy. Previous training in interviewing to detect deception resulted in enhanced accuracy, but it involved at least a few hours of training (Hartwig, Granhag, Strömwall, & Kronkvist, 2006; Luke et al., 2016; Vrij, Leal, Mann, Vernham, & Brankaert, 2015), and considerably longer than the brief instruction participants in the current study received.

Although participants in the informed group indicated that they relied on the information provided in the instruction, their accuracy was not higher than participants in the uninformed group. However, the self-reported cues showed that the majority of participants relied on unreliable cues, including the informed ones. This finding is consistent with previous research that shows that laypeople and practitioners tend to hold incorrect beliefs about deception (Global Deception Research Team, 2006; Strömwall, Granhag, & Hartwig,
The results for the informed group support that such views are difficult to change.

Reliability of the reported cues was also not related to the accuracy of judgements. That is, participants who reported reliable cues were as inaccurate as participants who reported unreliable cues. This result could perhaps be best explained by the finding that the number of reported reliable cues was very low in general.

One limitation of this study was that lay people, mostly students, took part. It is unknown how professionals (e.g., police officers) would perform in this study. In addition, participants were given only brief instructions about the veracity cues to base their judgements on. Apart from short guidance, it is unknown how the instruction in the informed group was perceived. For example, how and when the observers interpreted small or large amount of details in the reports, what kind of details they put emphasis on while reading the statements, whether participants read the entire interviews attentively, etc. These considerations should be addressed in future lie detection studies.

In conclusion, the current study showed that even when observers are given information about reliable cues to deception, they still used unreliable cues when making veracity judgements. Future studies could focus on examining the ways to prevent people from making veracity decisions based on unreliable cues.
Chapter 6: General Discussion
6.1 Summary of the findings

The aim of this thesis was to examine how different mnemonic techniques used in an interview conducted immediately after an event affected truth tellers’ and liars’ responses in the immediate and delayed interviews. In Tables 6.1 and 6.2 summaries of the findings are presented. In these tables the magnitude (effect sizes) of the differences between truth tellers and liars with respect to the amount of reported details and consistency measures are shown. Cohen’s $d$ effect size tells us by how many standard deviations the means of the groups differed.

According to the general guidelines, the sizes indicate small (0.2), medium (0.5), or large (0.8 and above) effects (Fritz et al., 2012). Thus, the larger the effect size, the bigger difference between truthful and deceptive responses was obtained.

With respect to the amount of reported visual, spatial, temporal, and action details, the achieved effect sizes ranged from medium to large for the immediate (0.52-2.05) and delayed responses (0.58-2.16) across three studies in which participants were questioned using mnemonic techniques. The only veracity effect not found to be statistically significant was for the amount of visual details in the delayed interview in Study II. In terms of consistency characteristics, significant effect sizes were obtained only in Study III. In sum, the findings suggest that truth tellers and liars differed substantially in the amount of provided information immediately and after a two-week delay. However, there were fewer differences between truth tellers and liars with respect to their consistency between the immediate and delayed statements. The interpretation of the findings will be elaborated on below.
### Table 6.1

*Summary of the Cohen’s $d$ effect sizes of the amount of reported details using different mnemonic techniques. A positive $d$ score indicates that truth tellers reported more details than liars. Scores in bold refer to significant differences.*

<table>
<thead>
<tr>
<th></th>
<th>Visual</th>
<th>Spatial</th>
<th>Temporal</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Immediate interviews</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Study I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Context reinstatement (CR)</td>
<td>0.52</td>
<td>0.83</td>
<td>1.56</td>
<td>1.60</td>
</tr>
<tr>
<td>Sketch</td>
<td>0.68</td>
<td>1.34</td>
<td>2.09</td>
<td>1.61</td>
</tr>
<tr>
<td>Event-line</td>
<td>1.13</td>
<td>1.23</td>
<td>1.08</td>
<td>1.47</td>
</tr>
<tr>
<td><strong>Study II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sketch</td>
<td>0.88</td>
<td>1.27</td>
<td>0.91</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Study III</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Report everything</td>
<td>1.48</td>
<td>1.37</td>
<td>2.05</td>
<td>2.01</td>
</tr>
<tr>
<td>Spatial questions</td>
<td>0.87</td>
<td>1.25</td>
<td>1.00</td>
<td>0.91</td>
</tr>
<tr>
<td><strong>Delayed interviews</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Study I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR</td>
<td>0.58</td>
<td>0.74</td>
<td>1.21</td>
<td>1.19</td>
</tr>
<tr>
<td>Sketch</td>
<td>0.73</td>
<td>1.11</td>
<td>1.76</td>
<td>1.43</td>
</tr>
<tr>
<td>Event-line</td>
<td>1.14</td>
<td>1.40</td>
<td>0.78</td>
<td>1.15</td>
</tr>
<tr>
<td><strong>Study II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sketch</td>
<td>0.51</td>
<td>0.93</td>
<td>0.75</td>
<td>0.91</td>
</tr>
<tr>
<td><strong>Study III</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Report everything</td>
<td>1.96</td>
<td>1.73</td>
<td>1.83</td>
<td>2.16</td>
</tr>
<tr>
<td>Spatial questions</td>
<td>1.30</td>
<td>1.49</td>
<td>1.90</td>
<td>2.06</td>
</tr>
</tbody>
</table>
Table 6.2

Summary of the Cohen’s d effect sizes of the consistency variables between statements.

Positive scores show that truth tellers provided more details than liars. Negative scores show that liars provided more details than truth tellers. Scores in bold refer to significant differences.

<table>
<thead>
<tr>
<th></th>
<th>Reminiscence</th>
<th>Repetition</th>
<th>Omission</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study I</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR</td>
<td>0.14</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>Sketch</td>
<td>0.07</td>
<td>0.29</td>
<td>0.29</td>
</tr>
<tr>
<td>Event-line</td>
<td>0.09</td>
<td>0.14</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>Study II</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sketch</td>
<td>0.54</td>
<td>0.09</td>
<td>0.09</td>
</tr>
<tr>
<td><strong>Study III</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Report everything</td>
<td>0.48</td>
<td>1.22</td>
<td>-1.22</td>
</tr>
<tr>
<td>Spatial questions</td>
<td><strong>1.48</strong></td>
<td>0.78</td>
<td>-0.78</td>
</tr>
</tbody>
</table>

6.2 Veracity and the immediate interviews

In Study I, truth tellers reported more visual, spatial, temporal, and action details than liars when asked to report everything they remembered in the immediate interviews. As expected, these differences were found across all three mnemonic conditions. This finding is in line with previous research that has shown truth tellers to be more detailed than liars when interviewed shortly after the event (Vrij, 2008; 2016). In Study I, both veracity groups were tasked to be believed by the interviewer in order to get full compensation for participation. Furthermore, participants were told that they would be believed if the interviewer felt that they reported everything they remembered. However, even this instruction to report in as much detail as possible was not sufficient for liars to provide as many details as truth tellers.
did in their immediate accounts. Liars could experience more difficulties than truth tellers to follow the interviewer’s instruction due to lack of imagination, or information-management issues, because reporting too many fabricated details would give possible leads to the interviewer that they were lying (Granhag & Hartwig, 2008; Vrij et al., 2017).

Examination of participants’ responses to mnemonic techniques separately showed that there was no difference in the amount of visual, spatial, temporal, and action details between truth tellers and liars when the CR mnemonic was administered. In other words, using this mnemonic alone was ineffective for facilitating discrimination between truth tellers and liars. A comparison between the three mnemonic techniques showed that CR elicited a lower amount of detail than the sketch or event-line (for truth tellers and liars combined). This suggests that truth tellers benefitted the least from the CR mnemonic. Liars could be less affected by specific mnemonic technique administered due to the information-management strategies they typically employ (Hartwig et al., 2010). That is, liars might stick to their fabricated stories, regardless of the mnemonic (CR, the sketch, or the event-line) given to them. The event-line mnemonic was the most effective in distinguishing truth-tellers and liars. The stimulus event (break-in) shown to participants was dynamic. Perhaps the event-line facilitated reporting different activities more than CR or the request to sketch, which particularly benefitted truth tellers.

In Study II, where only the sketch mnemonic was used, truth tellers provided more visual, spatial, temporal, and action details in the immediate interviews than liars. Although this finding was predicted, it is worthwhile discussing the difference between veracity groups regarding the amount of temporal and action details. Specifically, in the sketch instruction participants were asked to draw and then describe in as much detail as possible the layout and the location of the objects of the place where the break-in happened. No instruction to provide temporal and/or action information was given to the interviewees. Nevertheless, truth
tellers reported more temporal and action details than liars while describing the sketch. It seems that truth tellers mentioned additional information not asked for in the instruction, whereas liars merely followed the instruction. Liars reported very few temporal and action details compared to visual and spatial details, which supports this interpretation of the findings. A reluctance to reveal additional details found in this study reflects the avoidance strategies typically used by liars (Hartwig et al., 2010).

When different immediate interviewing formats were compared in Study III, truth tellers provided more visual, spatial, temporal, and action details than liars in both interviewing conditions. However, the difference between veracity groups was larger when the broader report everything instruction was used compared to when the more specific spatial questions were asked. This finding suggests that instructions to report as many details as possible is more efficient for lie detection purposes than asking more specific questions. The result is consistent with previous research that compared different questioning approaches (e.g., the Cognitive Interview (CI) vs. standard questions) (Bembibre & Higueras, 2011; Hernández & Alonso-Quecuty, 1997), and is in line with the Cognitive Credibility Assessment (CCA; Vrij, 2018) approach.

In summary, the experiments conducted in this study showed that truth tellers provided more detailed accounts than liars when interviewed shortly after the event, but that the difference between truth tellers and liars was affected by the technique employed in the interview.

6.3 Veracity and the delayed interviews

In Study I truthful statements contained more visual, spatial, temporal, and action details than deceptive statements across three mnemonic conditions in the delayed interviews.
These results indicate that the credibility cue amount of detail remained diagnostic even after a delay. Similar findings were obtained in a recent study, in which participants were interviewed immediately and two weeks later (Nahari, 2018). However, in Study I larger differences than expected were found between truth tellers and liars in the delayed interviews. Specifically, in the sketch condition truth tellers produced more temporal and action details than liars after the delay. Differences only in the amount of visual and spatial details were expected because of truth tellers’ immediate recall practice of these details in the sketch. In the same manner, in the event-line condition differences between truth tellers and liars after the delay in the amount of temporal and action details only were expected.

However, truth-tellers also reported more visual and spatial details than liars in this condition after the delay. A possible explanation is that before the administration of each of the three mnemonic techniques, participants were asked in a free recall to describe what they had seen. Perhaps truth tellers could maintain good memories of visual, spatial, temporal, and action details after the delay because of immediate practice of these details in the free recall. Memory research has shown beneficial effects of initial testing on subsequent recall of learned information (Roediger & Butler, 2011; Pansky & Nemets, 2012). Immediate reporting of visual, spatial, temporal, and action details could strengthen truth tellers’ memory traces, thus, enhancing access to these details after a delay.

To understand better the effects of mnemonics, the immediate and delayed interviews in Study II included the sketch instruction only. As in the immediate sketch descriptions, truth tellers provided more spatial, temporal, and action details than liars after the delay. No difference was found in the amount of visual details after the delay, and this was unpredicted. Two explanations for the unpredicted finding are possible. First, since the sketch instruction focuses on visual details, liars may have been particularly encouraged to provide such details. Second, liars might have thought it a ‘safe’ strategy to report visual details because it does
not give too many leads to investigators. For example, liars can provide visual details that are typically found in a staff room e.g. information about furniture, kitchen utensils, or electric devices. Accounts that include such information are less likely to contradict factual evidence. However, reporting too many spatial, temporal or action details might have put liars at risk of revealing self-incriminating evidence. For example, information about locations of objects, specific times and/or activities can be potentially checked by investigators (e.g. CCTV records or asking neighbours who could have witnessed the event in question). It is known that liars tend to avoid reporting self-incriminating evidence (Gran Hag & Hartwig, 2008).

In Study III, in both report everything and spatial questions conditions delayed truthful statements contained more visual, spatial, temporal, and action details than delayed deceptive statements. However, the differences between truth tellers and liars regarding visual and action details were larger when the report everything mnemonic rather than the spatial questions were employed in the immediate interview. These findings could be explained by examining liars’ and truth tellers’ responses in the immediate interview. Liars’ responses were unaffected by the type of questioning in the immediate interview, but truth tellers provided less information (visual and temporal details, in particular) in the spatial questions condition than in the report everything condition. Thus, truth tellers who provided less detailed statements in the immediate interview, also provided less detailed responses after the delay, resulting in less pronounced differences between truth tellers and liars after a delay. In summary, the results demonstrated that truthful accounts were more detailed than deceptive accounts after the delay, and that the extent of the differences between truth tellers and liars was influenced by the techniques used in the immediate interviews.
6.4 Comparison between immediate and delayed statements

In this thesis how the amount of reported details by truth tellers and liars changed between immediate and delayed interviews was of interest. Recent deception studies introduced the concept ‘stability bias’, which refers to liars’ difficulty to understand the nature of human memory, particularly the tendency to overestimate memory performance (Harvey et al., 2017; Nahari, 2018). This suggests that the forgetting curve – the tendency to forget details over time - typical for truth tellers, would be less pronounced or even absent in liars. In Study I, truth tellers in the CR condition reported fewer temporal details in the delayed than in the immediate interviews. In addition, in the event-line condition truth tellers provided fewer visual details in the delayed than in the immediate interviews. Liars did not show a decline in the amount of any types of detail after the delay in these two mnemonic conditions. However, in the sketch condition, both truth tellers and liars showed a decline in reporting information. Truth tellers provided fewer temporal and action details, and liars provided fewer visual and action details in the delayed compared to the immediate interviews. In other words, when looking at the general reporting patterns of truth tellers and liars in each mnemonic condition, it became clear that both veracity groups showed a decline, including non-significant, in reporting details in the delayed interviews compared to the immediate interviews. Therefore, based on the findings of Study I, it cannot be concluded that only truth tellers showed a decline in reporting information after the delay.

Studies II and III showed more evidence for the predictions regarding how truth tellers and liars report information over time. In Study II, truth tellers provided fewer action details in the delayed than immediate sketch descriptions, whereas liars did not show such a decline in any types of detail. In addition, truth tellers and liars showed slightly different tendencies of reporting information between immediate and delayed interviews. There was a
marginal decline in the amount of visual, spatial, and temporal details in truthful responses after a delay, but a marginal increase in the amount of visual, spatial, temporal, and action details reported by liars after a delay. In Study III, truth tellers reported fewer temporal and action details in the delayed than immediate interviews, whereas liars did not show such a decline in the amount of any types of reported detail. In addition, truth tellers showed a marginal decline in reporting visual and spatial details after a delay, whereas liars showed a marginal increase in reporting visual, spatial, temporal, and action details after a delay.

The different findings between Study I and Studies II and III can only be speculated about. Observation of the means of visual, spatial, temporal, and action details reported by liars in the immediate interview suggests that in Study I the scores were considerably higher than in Studies II and III. Therefore, in Study I, liars could more easily afford to report fewer details in the delayed statements without thinking it would make them appear suspicious than in Studies II and III. Liars believe that reporting a sufficient amount of details is important for them to be believed (Hartwig et al., 2007; Nahari et al., 2014). Moreover, liars could also experience forgetting (Nahari, 2018) and this is more likely when a lot of details were given initially. Nevertheless, this interpretation should be considered with caution and requires further examination. Overall, the findings of this thesis showed that in terms of the amount of details provided over time, truth tellers more often than liars showed a decrease in reporting information after a delay. Truth tellers could be affected by a time delay more than liars. If truth tellers relied on their memories and this resulted in less information remembered after two weeks, liars could be primarily preoccupied to provide convincing stories, regardless of the time interval between an event and interview. In order to be convincing, the fabricated story needs to contain sufficient amount of detail.
6.5 Consistency between immediate and delayed statements

In Studies I and II truth tellers and liars provided a similar amount of reminiscences, repetitions, and omissions when the immediate and delayed statements were compared, indicating that both veracity groups were equally consistent between their accounts. These results are in line with the literature (Granhag & Strömwall, 2002; Vredeveldt et al. 2014, Granhag et al., 2016). Perhaps it was not a difficult task for liars to be as consistent as truth tellers because in both studies the immediate and delayed interviews contained the same instructions. Inconsistencies can emerge if the interview format changes, but may be less likely when it is held constant (Deeb et al., 2017; Leins et al., 2012). Furthermore, responses in the post-interview questionnaire revealed that in both studies liars thought more often about their fabricated story than truth tellers about the actual event between the immediate and delayed interviews. This suggests that liars were employing a ‘repeat’ strategy more often than truth tellers, which could facilitate consistency. However, these outcomes of the responses in the post-interview questionnaire should be interpreted with caution. It is reasonable to doubt the ability of participants’ to accurately estimate how many times they remembered the story during a two-week period.

Similar to Studies I and II, the results of Study III revealed that truth tellers and liars reported a similar amount of reminiscences between the two interviews in the report everything condition. However, truth tellers mentioned more reminiscent details than liars in the spatial questions condition. Perhaps truth tellers had the opportunity to provide additional details in the delayed interview because they were instructed to report all they could remember in that interview. Thus, details which were not mentioned in the immediate interview when spatial questions were asked were reported in the delayed interview. However, given liars’ strategy to keep it simple and to repeat what they said before (Granhag
& Hartwig, 2008; Granhag & Strömwall, 1999), they could not report too much additional information in the delayed interview. Additionally, in Study III truth tellers provided more repetitions and omitted fewer details than liars in the delayed interview in both questioning conditions. These outcomes suggest that liars used a ‘keep the story simple’ strategy (Strömwall et al., 2006), because omitting details after a delay might prevent liars from contradicting themselves (Granhag & Strömwall, 1999). Overall, the findings of these studies suggest truth tellers were as consistent as liars between the immediate and delayed accounts, which is consistent with previous research (Vredeveldt et al., 2014).

Some of the consistency findings may seem to contradict the observations made before in this thesis, thus deserve further comment. Specifically, it was concluded that truth tellers, but not liars, showed a decline in reporting details between the immediate and delayed interviews. However, in this section it was mentioned that in Study III liars omitted more details than truth tellers, and truth tellers produced more repetitions than liars. This suggests that liars showed a larger decline in reporting details than truth tellers. The reason for these seemingly conflicting results is the different statistics used for the analyses of amount of detail and consistency variables. Therefore, these two analyses should be interpreted independently from each other. In the amount of detail analysis, the actual amount of reported visual, spatial, temporal, and action details were compared. When the between-statement consistency characteristics were assessed, total amount of detail in the immediate interview was used as a covariate. It is reasonable to assume that without entering the covariate, truth tellers would produce more reminiscences, repetitions, or omissions than liars, but this would be the result of truth tellers’ initial statements being richer in detail rather than the result of difference in consistency between truth tellers and liars. This possibility was tested which confirmed that in Studies I, II, and III truth tellers showed the tendency to produce more (in)consistency characteristics compared to liars.
6.6 Observers’ accuracy of veracity judgements

In this thesis whether the actual differences between truth tellers and liars with respect to amount of details reported could be accurately detected by observers was also examined.

In Study IV, participants either did or did not receive an instruction about the findings of Study I. Participants in the informed condition should have considered these findings when making veracity judgements. It was found that the informed and uninformed participants did not differ in their accuracy of veracity judgements.

Although participants in the informed group indicated that they relied on the information provided in the instruction, their accuracy was not higher than participants in the uninformed group. This can be explained by the self-reported responses, which showed that the majority of informed and uniformed participants relied on unreliable cues when making their judgements, such as ‘speech errors, hesitations’, or ‘consistency’. This finding is in line with previous research showing that laypeople and practitioners tend to hold incorrect beliefs about deception (Global Deception Research Team, 2006; Strömwall et al., 2004; Vrij, 2008). The results for the informed group support that such views are difficult to change. Different explanations have been proposed about the origin of the incorrect beliefs to deception. For example, the moral explanation refers to the stereotypical view that lying is bad (Vrij, 2008). If lying is bad, then people should feel ashamed and/or nervous about it and, therefore, display signs of nervousness (e.g., commit speech errors) (DePaulo et al., 2003). The current study showed that signs related to nervousness (speech errors, hesitations) were amongst the most prevalent cues mentioned by participants. In addition, the exposure explanation suggests that stereotypical behaviours associated with deception are prominent in the popular media (Vrij & Granhag, 2007). For example, a popular crime drama TV series ‘Lie to Me’ depicted the main character as a highly skilful security officer in detecting deception. However, many
of the interviewing tactics and ‘signs of deception’ shown in these series were not consistent with scientific evidence (DePaulo et al., 2003; Hartwig & Bond, 2011; Vrij & Granhag, 2012).

A possible explanation for poor accuracy rates is that the instruction given to the informed group was not effective to achieve improvements in veracity judgements. Previous studies that resulted in enhanced lie detection accuracy involved at least a few hours of training including theoretical information about reliable and unreliable cues to deception, practical examples, exercises, and feedback on trainees’ performance (Hauch et al., 2016; Luke et al., 2016; Vrij et al., 2015), and considerably longer than the brief instruction participants in Study IV received.

The reliability of the reported cues was also not related to the accuracy of judgements. That is, participants who reported reliable cues were as inaccurate as participants who reported unreliable cues. This result could perhaps be best explained by the finding that the number of reliable cues reported by observers was very low in general. In conclusion, the results of Study IV showed that even when observers were given information about reliable cues to deception, they still used unreliable cues when making veracity judgements, which negatively affected their veracity judgements.

6.7 Empirical and practical contributions

The research conducted for this thesis advances knowledge about deception in three ways. First, the results of this thesis replicated previous findings that truthful statements contain more details than deceptive statements when participants are interviewed immediately after an event (Amado et al., 2016; DePaulo et al., 2003; Vrij, 2008). The current research has also provided evidence that truth tellers are able to report more details
than liars after a two-week delay. Not many studies have examined the credibility cue ‘amount of detail’ after a passage of time, when an immediate interview was also conducted (Granhag & Strömwall, 2002; Granhag et al., 2003; Nahari, 2018). Furthermore, no deception studies addressed the differences between truth tellers and liars in delayed interviews, after using mnemonic techniques in the immediate interviews. Second, in the current research, truth tellers and liars have shown somewhat different patterns of reporting information over time. The tendency of truth tellers to provide more details in the immediate than in the delayed interview resembled memory decay (Ebbinghaus, 1885/1913). However, liars showed a weaker tendency to demonstrate such a decline in reporting information, a phenomenon termed ‘stability bias’ in the deception literature (Harvey et al., 2017). Third, the findings indicate that truth tellers were as consistent as liars between their statements (Vredeveldt et al., 2014). This is an important finding and confirms that unless specific techniques (e.g., SUE; Granhag & Hartwig, 2015) designed to induce inconsistencies in liars-are used in interviews, ‘(in)consistency’ should be considered as an unreliable cue to detect deception.

In terms of practical relevance, the current findings suggest that the way someone is interviewed initially has an effect on credibility assessments in subsequent interviews. Previous studies demonstrated the benefits of high-quality immediate interviewing in terms of interviewees’ memory performance (Gabbert et al., 2009; Hope et al., 2014), but this may also apply to credibility assessments. The findings in this thesis might be relevant in different interviewing settings. For example, it might be useful for frontline officers or emergency call handling officers to obtain high-quality and complete accounts from witnesses or victims for possible repeated interviewing at the later stages of the investigation. The same could be applied with interviewing suspects, who especially tend to be interviewed more than once during the course of criminal investigations (Kassin et al., 2007); or within the intelligence
settings (e.g., when interviewing informants). However, the findings of this research should be implemented with caution regarding suspect interviewing situations. Specifically, interviewing the suspect early after an event without having sufficient evidence may hamper the entire investigation and so when someone gets arrested shortly after an incident, it is normal practice for police officers to spend time gathering case evidence planning interview tactics, etc. Hence, there will always be (at least) a short delay between an incident and interviewing a suspect. Nevertheless, given the findings of this thesis, practitioners need to be aware that delaying interviews with suspects may negatively affect his/her memory and, thus, their ability to detect deception.

The effect sizes of the differences between truth tellers and liars showed that report everything, sketch, and event-line mnemonic techniques were effective to detect deception. Thus, it is recommended that for credibility assessment purposes every interviewee should be invited to recall in as much detail as possible all they remember. Mnemonic techniques such as sketch and event-line should be also incorporated in interviewing settings for verbal lie detection. It can be argued that using techniques developed to enhance truth tellers’ reporting of information can also, to some extent, increase the amount of information in liars’ statements and may complicate deception detection. The more details liars provide, the more credible they may appear. Indeed, the absence of a specific threshold (cut-off score) in the amount of detail when the interviewees are lying and when telling the truth does not allow to make straightforward correct veracity judgements (Vrij, 2016). However, elicitation of more details from both truth tellers and liars gives an opportunity to the investigator to check these details, or compare them with the new evidence that appeared.

Finally, brief information about deception cues demonstrated to be ineffective in improving observers’ accuracy in veracity judgements. Although in Study IV veracity judgements were made by lay participants, findings of this study could give insight into how
to develop or improve training programmes on interviewing/deception detection for legal professionals. For example, training could involve not only informing trainees about reliable cues but also informing them about unreliable cues. Such training also could include information about the reasons why some cues are reliable and other cues are unreliable.

6.8 Methodological considerations

The main aim of this thesis was to examine how different mnemonics employed in an immediate interview affect reporting specific types of detail in both immediate and delayed interviews. As a result of this aim Studies I, II, and III did not contain standard control groups in which participants would be provided with the instructions eliciting less complete accounts. An absence of control conditions made it impossible to conclude whether the use of mnemonic techniques in the immediate interviews as such, have influenced the interviewees’ responses. This approach to the design of the studies can be considered a limitation in that it confines us to conclude that these effects would not be achieved without the use of mnemonics in the immediate interview. However, it is reasonable to assume that mnemonics used in the initial interviews were helpful to detect deception in the delayed interviews for two reasons. First, research has shown that liars tend to show a stability bias (Vrij et al., 2009; Harvey et al., 2017; Nahari, 2018), whereas truth tellers’ memory of an event becomes weaker over time, resulting in them reporting fewer details over time (Ebbinghaus, 1885/1913; Lawson & London, 2015; Tuckey & Brewer, 2003). The combined effect is that over time the difference between truth tellers and liars in reporting details becomes less pronounced. It can be assumed that in the absence of immediate interviewing, the two-week delay employed in these experiments was a considerable amount of time to show a substantial decrease in recalled information for truth tellers. However, in all three experiments, truth
tellers’ decline in reporting details was rather small, with the result that truth tellers reported more details than liars even after a delay. The results further showed that the majority of details truth tellers reported in the delayed interviews were repetitions of what they said in the immediate interviews. This suggests that truth tellers had relatively good memories of their initial responses. Second, a comparison between two types of immediate questioning in Study III showed that the report everything mnemonic was more effective (although modestly) than asking spatial questions to discriminate between truth tellers and liars after the delay. Given the magnitude of the effect sizes, it can be argued that in the spatial questions condition the differences between truth tellers and liars in the delayed interviews were also large. Indeed, the way these questions were formulated (e.g., ‘describe the interior of the staff room’) suggests that they were in line with investigative interviewing guidelines, and after asking such questions relatively complete answers could be expected (Oxburgh et al., 2010). Nevertheless, no reason can be identified why the quality of the immediate interview (e.g., eliciting short answers from the interviewees) would not affect deception detection after the delay.

In Studies I to III, all participants were instructed that the apartment they broke in to was a staff room of a community centre. This was to minimise the risk of liars telling an embedded lie. However, this instruction could not eliminate the possibility for some participants of using embedded lies. For example, some interviewees could report details of staff rooms they have genuinely visited. However, the obtained effect sizes of the differences between truth tellers and liars with respect to the amount of reported details suggest that possible use of embedded lies did not substantially influence the direction of the findings of this research.

Noteworthy, in each experiment interviewers conducted interviews with more than one participant. This could be considered as a limitation because the interviewer could figure
out whether a person was telling the truth or lying after interviewing a few participants. Specifically, reports of all truth tellers were similar because their accounts were based on a genuine memory of the same event (i.e., a video of the break in), whereas each lying participant had to create an individual cover story that would be different to the video break in. Thus, it is reasonable to presume that the interviewers became aware of the veracity conditions in the process of data collection, which could have unintentionally impacted the way in which they interviewed. However, the interviewer is believed not to have affected the results of Studies I, II and III for two reasons. First, all interviewers (research assistants who were university students or staff members) were trained by the author of the thesis prior to the beginning of data collection of each study. Specifically, in every interview they were strictly required to use prepared scripts. Moreover, the interviewers were instructed to actively listen to the responses of the interviewees’, make pauses long enough to continue or finish the interview only when being sure that the participant’s response had been fully provided. Second, even if the interviewers started realising who truth tellers and liars were in the process of questioning different participants, they were still blind to the aims and hypotheses of the experiments. Therefore, it is believed the risk of the interviewers’ knowledge to somehow affect the responses of the interviewees (e.g., liars’ reporting fewer details than truth tellers) was low.

A staged filmed event was used as a stimulus material across the three experiments. Participants were instructed to passively watch the staged event and to pretend their active involvement in the break-in. The benefit of such a controlled setting is that all participants witnessed exactly the same event, ruling out differences in exposure between participants or conditions. However, it is unknown whether real participation in the break-in would have resulted in different outcomes in the three experiments. It may have affected the amount of details reported in an undefined manner: It could result in more details being reported due to
participants paying more attention to the event, or fewer details being reported due to
distractions.

Another aspect of ecological validity is that the majority of participants across the
studies comprised students or members of the general public rather than legal professionals.
Samples with more representative participants (e.g., intelligence officers with a greater
insight into covert operations than laypeople) would bring more value into the current
findings. It is unknown how the knowledge and/or experience in the subject matter would
affect deceptive responses. Again, the amount of details reported may be affected in an
undefined direction: liars could provide convincing accounts with many details, or, in
contrast, be more careful and report fewer details to avoid the risk of incriminating
themselves.

6.9 Future directions

The research conducted for the current thesis provides a basis for future research to
examine, in greater detail, the mnemonic techniques to detect deception in repeated
interviews. This line of research could be further extended in several areas.

Future studies could focus on different interviewing situations, such as, the time span
between the critical event and questioning, also the number of interviews. Specifically,
further deception studies could examine the effects of mnemonic techniques on repeated
statements: i) when the first interview takes place after an extended period of time, that is,
more than the timespan during the studies of the thesis; and, ii) when someone is interviewed
on more than two occasions. These two scenarios are common in real life criminal
investigations. They are worthy of examination because the negative effect of time delay
(without retrieval practice) on memory and verbal deception detection is known (Ebbinghaus,
On the other hand, positive effects of mnemonic techniques to enhance reporting of information after a delay have been identified (Dornburg & McDaniel, 2006; Larsson, Granhag, & Spjut, 2003; Rivard et al., 2014).

Further, the use of mnemonic techniques in repeated interviews could be examined in high-stake situations. For liars, the consequences of being caught in real criminal cases are typically serious. The need for applied research has previously been advocated by scholars in legal psychology (Oxburgh, Walsh, & Milne, 2011; Porter & ten Brinke, 2010). Although it is difficult to consider a theoretical reason why the identified verbal differences between truth tellers and liars would not be present in real life circumstances (e.g., liars employing counter-interrogation strategies to a lesser degree than in the laboratory experiments), studies containing high-stake lying scenarios would promote ecological validity. It is also reasonable to expect that increasing ecological validity would encourage stakeholders to apply evidence-based findings within legal settings (Blair & Kooi, 2004). Furthermore, examining such situations can be beneficial. Specifically, some studies showed police officers were considerably more accurate when detecting high-stakes deception (Wright Whelan, Wagstaff, & Wheatcroft, 2015; Wright & Wheatcroft, 2017). However, the development of experimental set-ups may be complicated due to ethical considerations. Yet future laboratory studies could raise the stakes within ethical boundaries. A solution to these issues could be to increase participant rewards from modest (i.e., a prize worth of cinema ticket) to more solid compensation for participants trying their best to convince the interviewer.

Additionally, completion of a field study could be an important further step in verbal lie detection. This could involve, for example, real (recorded and/or transcribed) repeated interviews with suspects, in which the investigator(s) use information-gathering approaches including the mnemonic techniques. These interviews would meet the stringent criteria to
establish ground truth in order to compare truth tellers and liars. Such research would demand a thesis of its own, yet could greatly contribute to the verbal lie detection scientific literature.

The effectiveness of deception detection may depend on the conditions in which an event was encoded in memory (Harvey et al., 2017). There are plethora of everyday situations in which the encoding quality for the event experienced can be impeded e.g., as a result of incidental focus to specific details (Carlson, Dias, Weatherford, & Carlson, 2016), intoxication (Hagsand, Hjelmsäter, Granhag, Fahlke, & Söderpalm-Gordh, 2013), or poor viewing conditions (Wells & Olson, 2003). The role of mnemonic techniques to distinguish truth tellers and liars when encoding conditions are complicated is currently unknown.

In light of recent atrocities related to extremist organizations around the globe, deception researchers have also begun to address the issue of false intentions (Granhag & Mac Giolla, 2014; Sooniste, Granhag, & Strömwall, 2017; Vrij, Granhag, Mann, & Leal, 2011). In a recent study, CI showed benefits to detect false intentions (Sooniste, Granhag, Strömwall, & Vrij, 2015). This research could be extended to examine the effects of mnemonic techniques on repeated accounts across the passage of time when a critical event is planned, for example, few months in advance.

Finally, measuring the difference between truth tellers and liars in reporting visual, spatial, temporal, and action details is not entirely useful in real life investigations. Specifically, these types of details as such do not yield too much valuable information for criminal investigations. In the current thesis, these types of detail were examined because this was a first step to understand the effects of mnemonic techniques, used in the immediate interviews, on deception detection in delayed interviews. Thus, it was primarily focused on the quantity of details in the statements reported by truth tellers and liars. Future studies using mnemonic techniques could examine qualities of detail that have more forensic relevance, such as verifiable details (Nahari et al., 2014), or salient details (Deeb et al., 2018; Sakrisvold, Granhag,
& Mac Giolla, 2017) and their consistency between interviews. Examination of the quality of details may be important when extent of lying in deceptive stories is low. Studies conducted in the current thesis considered the self-reported extent of liars’ being truthful in the interviews (as asked in the post-interview questionnaires). However, the majority of liars’ stories contained fabrications (approx., 70-80%). Future deception studies focusing on the effects of mnemonic techniques could develop more challenging scenarios, in which liars would falsify only a minimal amount of information. Given the aims of the thesis, only between-statement consistency characteristics were examined. In future similar research, the other types of consistencies, within-statement, statement-evidence, or within-group, could be tested. As practitioners in criminal justice tend to put emphasis on (in)consistency as an indicator to detect deception (Bogaard et al., 2016), these examinations could extend the knowledge about consistency as a deception cue. Statement-evidence consistency may especially be of practical interest because in this situation the information reported by truth tellers and liars can be compared with real facts known about a criminal case.

6.10 Conclusions

The research presented shows that when mnemonics were used during the immediate interview, the verbal cue richness of detail remained a diagnostic cue to deceit even after a delay. In addition, truth tellers more often than liars showed a decline in reporting details after a delay. Truth tellers showed patterns of reporting indicative of genuine memory decay, whereas liars showed patterns of ‘stability bias’, a failure to accurately estimate memory decay (Harvey et al., 2017). Also, this research replicated previous findings demonstrating that truth tellers and liars are equally consistent when interviewed twice (Vredeveldt et al.,
Finally, it was found that lay observers showed poor accuracy in detecting truths and lies, and a strong reliance on incorrect stereotypical cues when making these judgements.

Overall, the findings indicate that mnemonic techniques such as a report everything, a sketch, or event-line in a first interview conducted shortly after the event are promising tools to deception detection in immediate and delayed interviews. This thesis contributed to the understanding of verbal deception detection in a repeated interviewing context.

Future research in the area of memory-based lie detection should continue to examine the effects of different mnemonic techniques in repeated interviewing in various investigative contexts, exploring various types of verbal information in the reports of interviewees.
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MacLeod, M. D. (2002). Retrieval-induced forgetting in eyewitness memory: Forgetting as a consequence of remembering. * Applied Cognitive Psychology, 16*, 135–149. DOI: 10.1002/acp.782


10.1080/10781910701665741


10.1177/0261927X94134007


Appendix A: Favourable ethics opinion (Chapter 2)
FAVOURABLE ETHICAL OPINION

Study Title: The development of a memory base lie detection tool
Reference Number: SFEC 2015-074(A)
Date Resubmitted: 19 February 2016

Thank you for submitting your updated protocol amendment to the Science Faculty Ethics Committee (SFEC) for ethical review in accordance with current procedures\(^1\). Thank you also for your written response to the original SFEC review and provisional favourable ethical opinion.

I am pleased to inform you that SFEC was content to grant a favourable ethical opinion of this protocol amendment on the basis described in the submitted documents listed at Annex A, and subject to standard general conditions (See Annex B). Please note that the favourable opinion of SFEC does not grant permission or approval to undertake the research. Management permission or approval must be obtained from any host organisation, including the University of Portsmouth or supervisor, prior to the start of the study.

It would be appreciated if you could let me know, in the coming months, whenever you have recruited sufficient volunteers, how many of the original Psychology Department Participant Pool students who originally volunteered requested to change their 2 course credits into a £10 award instead.

Wishing you every success in your research

\[\text{Signature}\]

Dr. Jim House
Vice-Chair Science Faculty Ethics Committee

\(^1\) Procedures for Ethical Review, Science Faculty Ethics Committee, University of Portsmouth, October 2012 (to be updated).
Appendix B: Favourable ethics opinion (Chapter 3)
FAVOURABLE ETHICAL OPINION

Study Title: Memory based lie detection: The effects of drawings on delayed repeated statements
Reference Number: SFEC 2016-067
Date Resubmitted: 22 July 2016

Thank you for resubmitting your application to the Science Faculty Ethics Committee (SEFC) for ethical review in accordance with current procedures\(^1\), and for making the requested changes following the first SFEC review, and for the clarifications provided.

I am pleased to inform you that SFEC was content to grant a favourable ethical opinion of the above research on the basis described in the submitted documents listed at Annex A, and subject to standard general conditions (See Annex B).

Please note that the favourable opinion of SFEC does not grant permission or approval to undertake the research. Management permission or approval must be obtained from any host organisation, including the University of Portsmouth or supervisor, prior to the start of the study.

Wishing you every success in your research

Dr Paul Morris
Vice-Chair Science Faculty Ethics Committee

Annexes

A - Documents reviewed
B - After ethical review - Guidance for researchers

\(^1\) Procedures for Ethical Review, Science Faculty Ethics Committee, University of Portsmouth, October 2012 (to be updated).
Appendix C: Favourable ethics opinion (Chapter 4)
FAVOURABLE ETHICAL OPINION

Study Title: Memory based lie detection: The effects of spatial questions on delayed repeated statements.

Reference Number: SFEC 2016-126

Date Re-Submitted: 30 January 2017

Thank you for resubmitting your application to the Science Faculty Ethics Committee (SFEC) for ethical review in accordance with current procedures, for making the requested changes following the first SFEC review, and for the very clear clarifications provided.

I am pleased to inform you that SFEC was content to grant a favourable ethical opinion of the above research on the basis described in the submitted documents listed at Annex A, and subject to standard general conditions (See Annex B).

Please note that the favourable opinion of SFEC does not grant permission or approval to undertake the research. Management permission or approval must be obtained from any host organisation, including the University of Portsmouth or supervisor, prior to the start of the study.

Wishing you every success in your research

Dr Jim House
Chair, Science Faculty Ethics Committee

Annexes

A - Documents reviewed
B - After ethical review - Guidance for researchers
Appendix D: Favourable ethics opinion (Chapter 5)
FAVOURABLE ETHICAL OPINION – FOLLOWING RESUBMISSION

Study Title: Verbal lie detection of immediate and repeated delayed statements: The role of event-line mnemonic.

Reference Number: SFEC 2017-096

Date Resubmitted: 13 October 2016

Thank you for resubmitting your application to the Science Faculty Ethics Committee (SFEC) for ethical review in accordance with current procedures, for making the requested changes following the first SFEC review, and for the clarifications provided.

I am pleased to inform you that SFEC was content to grant a favourable ethical opinion of the above research on the basis described in the submitted documents listed at Annex A, and subject to standard general conditions (See Annex B).

Please note that the favourable opinion of SFEC does not grant permission or approval to undertake the research. Management permission or approval must be obtained from any host organisation, including the University of Portsmouth or supervisor, prior to the start of the study.

Wishing you every success in your research

Dr Jim House
Chair, Science Faculty Ethics Committee

Annexes

A - Documents reviewed
B - After ethical review - Guidance for researchers
Appendix E: UPR 16
FORM UPR16
Research Ethics Review Checklist

Please include this completed form as an appendix to your thesis (see the Research Degrees Operational Handbook for more information)

<table>
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<th>Postgraduate Research Student (PGRS) Information</th>
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<td>PGRS Name:</td>
<td>Aleksandras Iztovas</td>
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<tr>
<td>Department:</td>
<td>Psychology</td>
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<tr>
<td>First Supervisor:</td>
<td>Prof. Albert Vrij</td>
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</tbody>
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| Start Date: | 01/09/2015 |
| (or progression date for Prof Doc students) | |
| Study Mode and Route: | |
| Part-time | ☐ |
| Full-time | ☐ |
| MPhil | ☐ |
| PhD | ☐ |
| MD | ☐ |
| Professional Doctorate | ☐ |

| Title of Thesis: | Memory based lie detection in repeated interviews: The importance of early use of mnemonics |
| Thesis Word Count: | 45,579 |
| (excluding ancillary data) | |

If you are unsure about any of the following, please contact the local representative on your Faculty Ethics Committee for advice. Please note that it is your responsibility to follow the University’s Ethics Policy and any relevant University, academic or professional guidelines in the conduct of your study.

Although the Ethics Committee may have given your study a favourable opinion, the final responsibility for the ethical conduct of this work lies with the researcher(s).

UKRIO Finished Research Checklist:
(If you would like to know more about the checklist, please see your Faculty or Departmental Ethics Committee rep or see the online version of the full checklist at: http://www.ukrg.org/what-we-do/code-of-practice-for-research/)

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<td>b) Have all contributions to knowledge been acknowledged?</td>
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<td>c) Have you complied with all agreements relating to intellectual property, publication and authorship?</td>
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<td>d) Has your research data been retained in a secure and accessible form and will it remain so for the required duration?</td>
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<td>e) Does your research comply with all legal, ethical, and contractual requirements?</td>
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Candidate Statement:
I have considered the ethical dimensions of the above named research project, and have successfully obtained the necessary ethical approval(s)

Ethical review number(s) from Faculty Ethics Committee (or from NRES/SCREC):
SFEC 2015-074(A), 2016-067, SFEC 2016-126, SFEC 2017-096

If you have not submitted your work for ethical review, and/or you have answered ‘No’ to one or more of questions a) to e), please explain below why this is so:

Signed (PGRS): [Signature]
Date: 28/09/2018

UPR16 – April 2018
Facilitating memory-based lie detection in immediate and delayed interviewing: The role of mnemonics

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High-value Detaliiare Intervention Group, Grant/Award Number: DIF-15-1299-V-001071.

Summary
We experimentally investigated how different mnemonic techniques employed in an interview conducted immediately after an event affected truth tellers’ and liars’ responses when they were interviewed again after a 2-week delay. We also compared how verbal accounts changed over time within truth tellers and liars, and how consistent both groups were. Participants (N = 143) were shown a mock intelligence operation video and instructed either to tell the truth or lie about its contents in two interviews, one of which was immediately after watching the video and the other after a 2-week delay. In the immediate interview, they were asked to provide a free recall and then asked to provide further information via one of three mnemonics: context reinstatement, sketch, or event-line. In the delayed interview, they were asked to provide only a free recall. Truth tellers reported more visual, spatial, temporal, and action details than did liars both immediately and after a delay. Truth tellers experienced more of a decline in reporting details after a delay than did liars, and this decline was affected by the mnemonic used. Truth tellers thus showed, more than liars, patterns of reporting indicative of genuine memory decay. Liars produced patterns of a “stability bias” instead. Truth tellers and liars were equally consistent between their immediate and delayed statements.

KEYWORDS
consistency, delay, memory, mnemonics, reality monitoring, repeated interviews, richness of detail, verbal lie detection

1 | INTRODUCTION

In deception research, truth tellers and liars are typically interviewed once, immediately after the event (Vrij, 2008, 2016), and truth tellers’ statements typically include more detail than do liars’ statements (Amado, Arce, Farina, & Vitaro, 2016; DePaulo et al., 2003; Vrij, 2008). However, in real-life investigative situations, it is very common for interviewees to be interviewed several times about the same target event and after different delay periods (days, weeks, or months: Goldsmith, Kroll, & Pamsky, 2005; Read & Connolly, 2007; Wyman, Scoboria, Gawrylak, & Memon, 2014). In the current experiment, truth tellers and liars were interviewed about a mock incident twice: immediately after the incident and 2 weeks later.

Although the difference between truth tellers and liars in terms of the amount of reported details is evident when they are interviewed immediately after an event (Vrij, 2005, 2008, 2015), in these few studies where participants were interviewed at different points in time, this difference tended to decline when interviews were conducted after a delay, making the credibility cue “richness of detail” less diagnostic over time (Harvey, Vrij, Hope, Lee, & Mann, 2017; McDougall & Bull, 2015; Vrij et al., 2009). This effect reflects different response patterns amongst truth tellers and liars. Truth tellers show “the
forgetting curve’ (Ebbinghaus, 1885) of memory: People forget information over time when there is no active attempt to retain it (Evans & Fisher, 2011; Lawson & London, 2015; Turtle & Yule, 1994). The passage of time weakens memory traces, thereby reducing access to the original information (Goldsmith et al., 2005; Penrod, Loftus, & Winkler, 1982; Schacter, 1999). In addition, studies examining witness’ episodic memory showed a reduction in recall of details in repeated retrieval attempts over time (Turtle & Yule, 1994; Tuckey & Brewer, 2003). Liar, however, shows a “stabilized bias” (Harvey et al., 2017). This bias refers to a metacognitive error to correctly understand the nature of memory decline over time (Kornell & Bjork, 2009). According to this concept, liars overestimate memory and fail to accurately calibrate their verbal output to take into account genuine memory decay.

Deception researchers have started to address memory-related factors affecting the statements of both truth tellers and liars in repeated and delayed statements (Harvey et al., 2017; McDougall & Bull, 2015; Vrij et al., 2009). In interviewing contexts, memory-related issues are important for two reasons: First, complete and accurate statements provided by cooperative witnesses or suspects are one of the main goals of investigative interviews (Geiselman et al., 1984; Kolbøl & Milne, 1999; Parsley & Nemtz, 2012). Memory retrieval for original information becomes more difficult over time, which can result in less complete statements. A decrease in forensically relevant reported information may negatively affect a criminal investigation. Second, a vague statement can raise doubts about someone’s credibility. Previous studies with police officers have shown that the amount of information provided is an important cue for them to decide whether or not an interviewee is credible (Akehurst, Kährskem, Vrij, & Bull, 1996; Stenwall & Granhag, 2003).

One factor that could facilitate retrieval of information even after long retention intervals is the use of memory-enhancing techniques (or “mnemonics”) (Fisher & Geiselman, 1992). Using mnemonics is valuable in real life because truthful interviewees can provide a lot of details valuable for criminal investigations, including descriptions of people, times of the criminal activities, and locations of various crime-related objects. It is also important to understand whether deceptive interviewees tend to respond differently to mnemonics after different retention intervals. We examined how different mnemonics affected immediately reported by truth tellers and liars and how these mnemonics affected their responses when they were interviewed again after a 2-week delay.

1.1 Mnemonics and deception

Memory-enhancing Interview techniques take into account two basic principles of human memory: (a) A memory trace has several features, and the effectiveness of a retrieval cue is dependent on the amount of overlap between the retrieval cue and the encoded event (Fiesler & Tulving, 1978); and (b) several retention paths to the encoded event may be available, so that information not accessible with one retrieval cue may be accessible with another (Tulving, 1974). Regarding the latter, a person may not report specifically where she or he placed an item in the room when asked a direct question but may recall a concrete location when requested to draw a layout of that room. Mnemonics are typically included in evidence-based investigative interviewing guidelines (Clarke & Milne, 2001; Clarke, Milne, & Bull, 2013; Fisher & Geiselman, 1992). Research has shown the advantage of using mnemonics over standard interviewing techniques in terms of eliciting more complete statements, without the cost of an inflated amount of inaccurate information (Davis, McMahon, & Greenwood, 2005; Fisher, Geiselman, & Amador, 1999; Memes, Moësner, & Fraser, 2010). Different types of mnemonic techniques have been adapted for use in investigative interviewing, three of which are introduced in this paper. Core restraint instruction (CRI) requires witnesses to mentally place themselves back in the experienced event (Fisher & Geiselman, 1992). Studies have shown memory improvement in recalling details when using this mnemonic in both children and adults (Priestley, Roberts, & Pipe, 1999; Wong & Read, 2011). Another technique, making a sketch of the crime scene, compared with standard questioning procedures, has also resulted in a more complete account of an event (Dando, Wilcock, Behnjik, & Milne, 2011; Dando, Wilcock, & Milne, 2009). Finally, the event-line mnemonic technique is based on the timeline interviewing format developed by Hope, Mulfis, and Gobbert (2013), which is related to reproducing temporal context and sequence of actions in an event. The timeline facilitated more correct information than did a free recall (FR) both immediately after an event and after a 2-week delay (Hope et al., 2013). In our study, we positioned CRI as a generic mnemonic, which is known as an effective memory-enhancing technique (Dando et al., 2009; Emnett, Clifford, & Gwyer, 2003; Fisher & Geiselman, 1992). We also sought to examine the effects of more specialized mnemonics (sketch and event-line) that target specific types of information (spatial or temporal) and contrast them with performance on a generic CR.

Previous findings also suggest that the use of mnemonics can aid in discriminating between truthful and deceptive statements, because truth tellers benefit more from such memory-enhancement techniques than do liars. Liars may lack the imagination to report as many plausible details as truth tellers, or they may be unwilling to do so out of fear that these additional details give checkable leads to investigators (Vrij, Fisher, & Blank, 2017). In one study, truth tellers and liars were interviewed with the cognitive interview, which contains various mnemonics, or with a standard interview protocol, which did not contain mnemonics (Hernández-Fernández & Alonso-Quercia, 1997). It was found that truth tellers reported more spatial, temporal, and sensory details than did liars, and the difference was largest when the CI was used. In another study, it was found that the CI was more efficient than a standard interview in discriminating between truth tellers and liars when examining actions and objects details (Remblië & Higueras, 2011). When the sketch mnemonic was introduced, it was found that a sketch resulted in more pronounced differences between truth tellers and liars than did a verbal recall (Vrij et al., 2009; Vrij et al., 2010). Thus, previous findings suggest that mnemonics can aid in eliciting more information about the event in question, but also in better discrimination between truthful and deceptive accounts, than can standard questions.

Regarding real-life interviewing settings, the application of mnemonics can be valuable because they do not require many resources (e.g., in contrast to polygraph machines) and are easy to implement and analyze (Mac Giolla, Granhag, & Vormhan, 2017, Vrij et al., 2010). Thus, these techniques can be useful for practitioners to make
inferences about the credibility of interviewees. As yet, it is unknown how different mnemonics affect not only immediate but also delayed statements reported by truth tellers and liars.

### 1.2 Consistency as a cue to deceit

In real-life testimonies, consistency is regarded as an important cue for making credibility judgements (De Keijser, Malisch, Kranendonk, & de Graaf, 2011; Granhag & Strömwall, 2001; Granhag, Mac Giolla, Soonior, Strömwall, & Liu-Johnson, 2016). Both laypeople and legal professionals tend to believe that consistency is indicative of truth telling, whereas inconsistency is a sign of lying (Bogaard, Keijzer, Virj, & Monshouwer, 2016; Granhag & Strömwall, 2008). Scientific evidence however has revealed an opposite pattern. Truth tellers can be equally or even less consistent in their statements than are liars (Granhag & Strömwall, 2002; Strömwall & Granhag, 2005; Vredeveeld, van Koppen, & Granhag, 2014). This pattern can be explained by the nature of memory functioning in truth tellers and strategies commonly used by liars to mimic credibility. Specifically, Granhag and Strömwall (1999) introduced the “repeat versus reconstruct hypothesis” regarding the relationship between consistency and deception. This hypothesis is based on two premises: First, liars believe that being consistent is important in order to come across as being credible, and they are therefore keen to repeat their original story when interviewed a second time. Second, truth tellers are less concerned with consistency than are liars (Hartwig, Granhag, & Strömwall, 2007; Hartwig, Granhag, Strömwall, & Doering, 2010). When interviewed a second time, truth tellers go back to their memory of the event and, due to the malleable nature of human memory (Baddeley, 1999; Loftus, 1979), may subsequently add, omit, or change details as a function of a repeated retrieval attempt (Hartwig et al., 2007; Hartwig et al., 2010). Therefore, when truth tellers rely on their memory of an event, their statements are likely to contain various types of inconsistencies (Vredeveeld et al., 2014). Consistency is related to repetition of the same details, whereas reminiscences (details reported in a subsequent account, not mentioned previously) and omissions (details reported previously but not in a subsequent account) are related to inconsistency (Vredeveeld et al., 2014).

There are four different types of consistency typically analysed in deception studies: (a) consistency between details within one statement, within-statement consistency; (b) consistency between different statements made by one person, between-statement consistency; (c) consistency between statements reported by different individuals about the same event, within-group consistency; and (d) consistency between the statement and evidence, statement-evidence consistency (Vredeveeld et al., 2014). Given our design and aims of the study, we will cover only the between-statement consistency. In this study, we examined the effects of three mnemonics on truth tellers’ and liars’ immediate statements and repeated statements after a 2-week delay: CR mnemonic, spatial mnemonic (using sketch), and temporal mnemonic (using event-line). In the immediate interview, truth tellers and liars were first invited in a FR to report everything they could remember about the event. After the FR, a mnemonic was introduced and the interviewees were again invited to report all they could remember.

Truth tellers and liars were then interviewed again after a 2-week delay (FR phase only).

### 1.3 Statement characteristics and hypotheses

The analysis of statements from truth tellers and liars was based on the reality monitoring (RM) approach (Johnson & Raye, 1981). The main assumption of RM is that memories based on real experiences differ in quality from fictional “recollections” (Masic, Sperer, Garrida, & Herrero, 2005; Virj, 2015). Perceptual processes are involved in memories of real experiences (Johnson & Raye, 1981). Therefore, it is likely that they will contain, amongst other types of detail, sensory (smell, taste, touch, visual, or auditory details) and contextual (spatial and temporal details) information. In addition, real memories are usually clearer, sharper, and more vivid than imagined memories, which typically contain less detail and are vaguer and less concrete (Virj, 2015). The amount of different types of RM detail (visual, spatial, temporal, and action) between truthful and deceptive statements was compared. (In)consistency characteristics of truth tellers and liars (reminiscences, repetitions, and omissions; Granhag & Strömwall, 2002) typically identified in deception literature were also analysed.

In this study, we were interested in the differences between the report content of truth tellers and liars in immediate and delayed interviews. As a result of retrieval practice in the CR condition, we expected that neither truth tellers nor liars would show a memory decline in reporting detail after a delay, and that truth tellers would report even more visual, spatial, temporal, and action details than would liars after a delay in the CR condition (Hypothesis 1). In the sketch condition, it was predicted that truth tellers would report more visual and spatial details than would liars after a delay as a result of practising those details in the sketch. We also expected that truth tellers, but not liars, would show a memory decline in temporal and action details after a delay, as these details would be less practised in the sketch (Hypothesis 2). In the event-line condition, it was predicted that truth tellers would report more temporal and action details than would liars after a delay as a result of practising these details in the event-line. Truth tellers, but not liars, would show a memory decline in visual and spatial details after a delay, as these details would be less practised in the event-line (Hypothesis 3). Finally, we were also interested in how consistent truth tellers and liars would be in immediate and delayed interviews in line with the above reasoning, we predicted that truth tellers would produce more reminiscences and omissions than would liars between immediate and delay interviews (Hypothesis 4).

Our immediate interview included two parts, an FR phase and a mnemonic phase, which we introduced due to its operational relevance. Specifically, in real-life situations, it is arguably more typical to start with a general open-ended question and then ask for more specific information. Furthermore, the recent investigative interviewing guidelines suggest to use free recall first and follow with mnemonic techniques (Milne & Bull, 1999; Milne, Shaw, & Bull, 2007). In our analyses of the immediate and delayed reports, comparisons were made only between the FR phases of the immediate and delayed interviews (the delayed interview only included an FR phase). We did not take into account the information provided in the mnemonic phase of the immediate interview for two reasons: First, comparisons
between immediate and delayed statements within conditions would be difficult in terms of the amount of details. In all experimental conditions, immediate statements would obviously be richer in detail because immediate interviews contain two phases whereas delayed statements only contain one. Second, different mnemonics could elicit different amounts of information due to their specifics. Therefore, it would also make comparisons of immediate and delayed reports complicated.

Although we did not specifically formulate hypotheses related to participants’ performance during the mnemonic part of the immediate interview, we considered it important to report the outcomes of this phase of the interview, as it gives further insight into how truth tellers and liars respond to mnemonics.

2 | METHOD

2.1 | Participants

A total of 143 participants took part in the study. Their mean age was M = 25.57 (SD = 12.55), and 35.7% were male. In the sample, 80.4% were undergraduate and postgraduate students, and 18.6% were members of the general public. Participants were recruited via posters, flyers, online participant pool system, and online advertisements on the University’s staff portal. As the experiment focused on the verbal content of the statements, native English speakers were prioritised to take part. The majority of participants (93.7%) were English native speakers; the remaining participants were fluent in English. Participants were awarded two course credits or £10 for taking part in the study. In addition, all participants were entered into a draw to win a single prize worth £150 on completion of the experiment. The study was approved by the Science Faculty Ethics Committee of the University.

2.2 | Design

A 2 (Veracity: Truthful vs deceptive) × 3 (Mnemonic type: CR vs. sketch vs. event-line) × 2 (Interview time: Immediate vs. delayed) experimental design was used with Veracity and Mnemonic as between-subject factors and Interview as within-subjects factor. Participants were randomly assigned as truth tellers (n = 76) and liars (n = 72). Truth tellers were randomly allocated to the CR (n = 24), sketch (n = 23), and event-line conditions (n = 23). Similarly, liars were randomly assigned to one of the three mnemonic conditions (CR, n = 23; sketch, n = 20; and event-line, n = 24). All participants were interviewed on two occasions. Immediately after the stimulus event and (approximately) 2 weeks later. Not all participants were available to be interviewed again after exactly 14 days, and so the delay period for the second interview varied between 8 and 21 days (M = 14.30, SD = 1.46, Mode = 14. 61.5% of cases).

2.3 | Materials

2.3.1 | Stimulus event

Participants were instructed to watch a video about a simulated break-in. They were instructed to imagine they were taking the role of an intelligence officer working undercover with another officer. They were told their task was to break into an apartment and secure some important intelligence information. This “special task” was recorded from the perspective of the person (e.g., participant) who followed the other “officer” throughout the break-in. Participants were explicitly instructed that they were “following their colleague” during the break-in.

The video event (lasting 5 min) shows a man entering a basement floor from the outside of the building. He then walks about 10 m through a corridor and tries to break into one of the doors at the end of the corridor. After a couple of attempts to open the door with a key, he walks into the room. The man in the video searches the room (desk, shelves, cupboards, clothes, etc.) He takes two mobile phones from a desk, a jewellery (necklace and two rings) from a cupboard, a laptop from a dining table, and a driving licence, debit card, and 25 euros and 20 dollars in cash from a wallet in a jacket. He then leaves the room with these items. As the man walks back along the corridor on his way out, a neighbour opens a door, witnesses him leaving, and immediately closes the door. The man who broke in stops and briefly looks around by the building exit. Finally, he leaves.

2.3.2 | Mnemonics

Three different memory-enhancing techniques used in this study are explained below.

Context reinstatement

This mnemonic consisted of asking interviewees to mentally recreate the to-be-recalled event, as well as their physiological, cognitive, and emotional states at the time of the event (Fisher & Geiselman, 1992). In our study, we instructed participants to (mentally) go back to the very start of the break-in, take a few moments to picture in their mind where they were, who they were with, and what they could see during the event including the descriptions of objects, locations, and the sequence of actions. Participants were asked to give themselves plenty of time to concentrate and visualise what happened during the break-in. Also, they were requested to shut their eyes while trying to remember the event.

Sketch

Interviewees were asked to sketch the event and then use that drawing to describe what they had experienced. Sketching the crime scene allows witnesses to initiate their own contextual retrieval cues (Paivio, Atalbargue, & Bull, 2013). The participants made their drawing on an A3-sized blank sheet of paper. They were requested to use as much space as they needed to sketch the apartment and as they remembered it. Participants were instructed to include as many details as possible about where different objects were in relation to other objects. They could also use labels and notes within their sketch to indicate the features of the scene or to indicate if they were not certain of something. After making the sketch, participants were asked to describe in as much detail as possible what they had witnessed during the break-in.

In the interview, the interviewee is also known as “Sketch’s Redescription of Context,” but the term “Sketch” can also be found (e.g., Hope, Gobbert, & Fisher, 2013; Rivard et al., 2014). In the deception literature, the term “Sketch” or “Drawing” is more common (e.g., Ross & Hietanen, Ohman, Granag, & Vrij, 2016; MacGuill et al., 2017; Vrij et al., 2013), which made us decide to use the latter.
Event-line
In this study, participants were instructed to write on an A3-sized sheet of paper with a graphical line (a grid divided into minutes) all actions from the event they could remember and to indicate on that line at what time these actions occurred. The grid was divided into six scale points (from 0 to 5 min) because the actual break-in lasted 5 min and 15 s. The grid was located in the right-top corner of the page, allowing enough space for participants to write underneath it. Participants were asked to write in the empty space and then put arrows on the event-line, indicating the time of the specific activities. After completing the event-line, participants were instructed to describe the event-line in as much detail as possible.

2.4 | Procedure
2.4.1 | Preinterview phase
After watching the break-in, each participant was instructed either to tell the truth or to lie during the interview. Truth tellers and liars were given almost identical instructions. To minimise the risk of liars telling an embellished lie (for example, by describing the apartment they genuinely lived in), all interviewers were told that the apartment they broke into was a staff room of a community centre. Truth tellers were told that the break-in was successful and that they would be interviewed by a fellow agent to continue the intelligence investigation. They were asked to report truthfully during the interview (a) the interior of the staff room in the video and (b) what they took from there. Liars were also told that the break-in was successful. However, they were told that they would be interviewed by an agent from a hostile organisation and that their task was, therefore, to reek out that agent. They were told that if the hostile agent came to know where exactly they broke in and exactly what was taken from the apartment, the entire investigation would be in jeopardy. They were instructed to tell the hostile agent a cover story that they broke into a different staff room in a different community centre. Therefore, liars were instructed to lie about (a) the interior of the apartment in the video and (b) what they took from there. To motivate all participants to do well in the interviews, they were told that they would receive two course credits or £10 and would only be entered in a draw to win £150 value prize if they were convincing during the interview. They were further told that if the interviewer thought that they did not report everything they remembered, they would only receive one course credit or £5, would be excluded from the draw, and would be asked to write down a full account of what happened in the video.

After the instructions to tell the truth or lie, participants were given unlimited time to prepare for the interview. They were given a blank sheet of paper and pen in case they needed to use them during their preparation. However, they were not allowed to take any notes they made to the actual interview afterwards. When participants indicated that they had prepared themselves, they were given a preinterview questionnaire in which both truth tellers and liars were requested to answer the questions truthfully. In the questionnaire, participants were asked to rate on 7-point Likert scales their preparation for the interview. They were asked to indicate how (a) well they were prepared (1 = very poor, 7 = very good) and how (b) sufficient (1 = insufficient, 7 = sufficient) and (c) complete (1 = incomplete, 7 = complete) their preparation was. We clustered these three preparation items into one variable, Preparation quality, as Cronbach’s α (0.86) indicated high consistency. The preinterview questionnaire also included questions on how (d) stressed (1 = not at all, 7 = very stressed), (e) motivated (1 = not at all, 7 = totally), and (f) confident (1 = not at all, 7 = totally) the participants felt about being convincing in the upcoming interview. This preinterview questionnaire was administered twice, before the both immediate and delayed interviews. Cronbach’s α for the preparation quality cluster was 0.86 for the delay interview.

2.4.2 | Interviews
Participants were questioned by an interviewer who was blind to the aims of the study, stimulus material, and veracity conditions. At the beginning of the immediate interview, participants in all experimental conditions were given the same FR instruction. They were asked to report everything they could remember from the break-in, including descriptions of objects and locations, the sequences of actions, and information about any people that were involved. After completion of this initial report, one of the three mnemonics (CR, sketch, or event-line) was administered. Then participants were asked for a second report, that is, to verbally reinstate the context, describe the sketch, or describe the event-line.

After the immediate interview, all participants were told that they would have to come back again in 2 weeks’ time. At the beginning of this delayed interview, the same procedure was used as in the immediate interview (instruction to tell the truth/lie, preparation, and preinterview questionnaire). Participants were then asked to provide an FR account about the break-in.

Our aim was that the same interviewer would conduct both interviews to avoid the risk of an interviewer influencing an interviewee’s accounts. However, some participants were interviewed by different interviewers due to time management issues (e.g., availability of participants, research assistants, or interviewees). The majority of participants (85.1%) were interviewed both times by the same interviewer, and two interviewers conducted the majority of the interviews (72.0%). To test possible random interviewer effects, we compared total details in the delayed accounts between participants questioned by the same interviewer during both interviews with participants questioned by different interviewers during the two interviews. The difference was not significant, t(141) = 0.83, p = 0.408, d = 0.39.

To achieve that interviewees followed identical instructions during preinterview and interview phases, preprepared scripts were used by the research assistants and interviewers.

2.4.3 | Postinterview questionnaire
After the delayed interview, participants were asked to fill out a postinterview questionnaire. As with the preinterview questionnaire, truth tellers and liars were requested to respond truthfully. The postinterview questionnaire included questions to assess (again, on 7-point Likert scales) what they thought the likelihood was of getting two credits or £10 and having to write a statement (1 = not at all, 7 = very likely). In addition, as previous research has shown that active repetition of learned information can buffer against memory decline, we asked participants in an open-ended question how many times
they had tried to remember the break-in (truth tellers)/cover story (liars) in the time between the two interviews. Lastly, we asked participants to assess the extent to which they (a) told the truth and (b) lied during the interviews. Answers were given on an 11-point Likert scale ranging from 0% (not at all) to 100% (totally). These two questions were asked twice to assess the truthfulness in both the immediate and delayed interviews.

After completing the questionnaire, participants were thanked and fully debriefed. All participants were paid £10 or given two credits for participation. After completing data collection, one participant was randomly selected as the £150 prize winner.

2.5 | Coding

2.5.1 | RM details

Interviews were transcribed verbatim. All statements were coded for the details provided by interviewees. Details were counted separately for responses to (a) FR, (b) one of three mnemonics in the immediate interviews, and (c) FR in the delayed interviews. Each detail was counted once per question response. For example, if the word "table" was mentioned twice during the FR in the immediate interview (and had the meaning of the same table), it was counted only once. However, if the same detail was mentioned in the different parts of the interview or different interviews, it was counted separately. Four types of detail were coded: (a) visual details: specific items/description of items seen by the interviewee. For example, "He walked through the double brown door," (b) spatial details: information about locations or spatial arrangements of people or objects. For example, "There were two doors on either side of the corridor and one door in front," and I was walking behind my colleague," (c) temporal detail: reference to the sequence of activities, their duration, or information when something happened: "When we got there, it took us about a minute to open the door," and "we quickly searched the room." (d) action details: information about the actions carried out by people in the event. "He picked up a laptop and left the room," contains four action details, and (e) action details: information about the actions carried out by people in the event. "He picked up a laptop, and left the room," contains four action details. This coding system is based on the RM approach (Johnson & Raye, 1981) and has been used frequently in previous deception research (Vrij, 2008).

Two coders carried out the coding. Both coders were trained by a senior member in the research lab. They received definitions and examples of the to-be-coded variables and were asked to code some practice statements. The trainer gave feedback on the coding and gave the coders a few more practice statements. The coders were given permission to start coding the interviews when the trainer was satisfied with their coding of the practice statements.

The first coder, the first author of this study, marked all transcriptions. The second coder, blind to the hypotheses, stimulus event, and veracity of the statements, marked a random sample of 29 interview scripts (20.26%) to measure reliability. Inter-rater reliabilities between the two coders for the frequency of detail in both immediate and delayed statements were measured via interclass correlation coefficients (ICCs). The ICC revealed excellent interrater values: 0.99, CI [0.98, 0.99] for visual details; 0.96, CI [0.95, 0.97] for spatial details; 0.92, CI [0.82, 0.94] for temporal details; and 0.97, CI [0.94, 0.98] for action details.

2.5.2 | Between-statement consistency

We measured consistency in the responses between the immediate FR and delayed FR. The RM details coded previously were used for consistency analysis. This time, we did not split details into visual, spatial, temporal, and action details but only examined the total amount of RM details. We made a distinction between repetitions (details repeated in both immediate and delayed FR), omissions (details reported in the delayed FR but not in the immediate FR), and omissions (details repeated in the immediate FR but not in the delayed FR). These measures are typically used in deception studies analyzing consistencies, as contradictions (the fourth aspect of consistency) do not occur often enough in most experimental deception research to be used in the statistical analyses (e.g., Deeb et al., 2017; Granhag et al., 2016; Granhag & Strömwall, 2002).

The coders only marked omissions. Repetitions and omissions were obtained by using arithmetic calculations. We coded details as reoccurrence in the delayed interview if they were not present in the FR of the immediate interview. Repetitions were computed by deducting omissions from the total amount of details in the delayed interview, and omissions were calculated by deducting repetitions from the total amount of details in the immediate FR.

The same two coders who marked the RM details were used for the consistency coding. The consistency training they received followed a similar format as the training they received for the RM details. Again, the first coder marked all transcripts, and the second coder marked 20.26% of the interview. We examined interrater reliability for consistencies only because that was the only measure coded manually. The analysis revealed moderate ICC of 0.71, CI [0.66, 0.75], consistencies in the delayed versus immediate FRs.

3 | RESULTS

3.1 | Manipulation checks

Mixed analyses of variance (ANOVA) with Interview as the within-subject factor and Veracity as the between-subjects factor were conducted for all manipulation checks. Table 1 shows mean scores, standard deviations, and confidence intervals for truth tellers and liars to the prequestionnaires and postquestionnaires.

The Veracity main effect was significant for Stress (liars felt more stressed than did truth tellers, F(1, 138) = 6.47, p = 0.012, d = 0.43). Confidence to convince the interviewer (truth tellers felt more confident than did liars) in their ability to convince the interviewer that they were telling the truth, F(1, 138) = 28.13, p = 0.001, d = 0.70, and How many times they thought about the event/story before the second interview (liars thought more often about the event than did truth tellers, F(1, 140) = 3.92, p = 0.02, d = 0.40). These results reflected the theoretical assumption that deception is more mentally taxing task than truth telling (Vrij, 2015). The Veracity main effect

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5When this variable was introduced as a covariate in the analysis, there was no significant effect in the delayed statement on total detail, F(1, 139) = 1.09, p = 0.298, $\eta^2 = 0.01$. Omissions, F(1, 138) = 0.17, p = 0.68, $\eta^2 = 0.001$, Repetitions, F(1, 140) = 2.90, p = 0.091, $\eta^2 = 0.02$, or Omissions, F(1, 138) = 0.40, p = 0.526, $\eta^2 = 0.003$. 

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was also significant for Extent of truthfulness (truth tellers were more truthful than lies during both the immediate, $F(1, 129) = 89.05, p < 0.001, d = 6.29$, and delayed interviews, $F(1, 139) = 85.74, p < 0.001, d = 5.98$, indicating that participants followed the instructions. All other Veracity main effects were not significant, all $F$s < 9.14, all $p$s > 0.165; see Table 1.

Main effects for Interview emerged for Motivation, $F(1, 137) = 4.39, p = 0.038, d = 0.16$. Participants were slightly more motivated before the immediate interview ($M = 6.15, SD = 0.81, 95\% CI [5.96, 6.35]$) than before the delayed interview ($M = 6.01, SD = 0.93, 95\% CI [5.92, 6.19]$). However, the means showed that participants were highly motivated before both interviews as their scores were at the upper end of the motivation scale. The Interview main effect was significant for the following: Preparation Quality, $F(1, 120) = 13.12, p < 0.001, d = 0.32$: Participants rated their preparation level higher before the immediate interview ($M = 5.27, SD = 0.98, 95\% CI [5.10, 5.44]$) than before the delayed interview ($M = 4.96, SD = 0.93, 95\% CI [4.77, 5.16]$); Preparation time, $F(1, 132) = 21.59, p < 0.001, d = 0.40$: Participants used more preparation time before the immediate interview ($M = 25.86, SD = 15.78, 95\% CI [23.21, 28.53]$) than before the delayed interview ($M = 19.81, SD = 14.50, 95\% CI [17.56, 22.06]$); and Stress, $F(1, 138) = 6.48, p = 0.012, d = 0.19$: Participants felt more stressed before the immediate interview ($M = 3.74, SD = 1.59, 95\% CI [3.48, 4.00]$) than before the delayed interview ($M = 3.44, SD = 1.56, 95\% CI [3.18, 3.70]$). The Interview main effect for Confidence was not significant, $F(1, 136) = 0.03, p = 0.869, d = 0.02$: Interview effects on quality of preparation, time for preparation, and stress level were probably found because participants were less familiar with the settings before the immediate interview than before the delayed interview.

Significant Veracity x Interview interaction effects emerged for Preparation time, $F(1, 132) = 4.33, p = 0.039, \eta^2_p = 0.03$. However, simple-effect ANOVAs revealed no differences between truth tellers and lies in the immediate, $F(1, 132) = 0.34, p = 0.575, d = 0.10$, and delayed interviews, $F(1, 132) = 2.43, p = 0.122, d = 0.27$. All other Veracity x Interview interaction effects were not significant, all $F$s < 3.92, $p$s > 0.050.

A one-way ANOVA with incentive as dependent variable revealed a significant main effect for Veracity. Truth tellers were more convinced than were lies that they would receive the full incentive of £10/2 credits. $F(1, 140) = 17.49, p < 0.001, d = 0.70$, see Table 1. A one-way ANOVA with Likelihood to write a statement as dependent variable revealed no significant main effect for Veracity. $F(1, 140) = 1.92, p = 0.17, d = 0.23$, see Table 1. (In the two later analyses, interview was not included as a factor as the question referred to the two interviews combined.)

In summary, the results showed that the manipulations in this study were successful.

### 4 EFFECTS OF VERACITY, MNEMONIC TYPE, AND INTERVIEW TIME ON THE RM DETAILS

To examine whether the amount of information changed between the immediate and delayed interviews, a mixed ANOVA was carried out with Veracity (Truth tellers vs. Lies) and Mnemonic FR in the CR vs. Sketch vs. Event-line as the between-subjects factors and Interview (immediate vs. Delayed) as the within-subject factor. With visual details as the dependent variable, a significant main effect emerged of Veracity, $F(1, 137) = 22.54, p < 0.001, d = 0.79$: Truth tellers ($M = 103.09, SD = 35.04, 95\% CI [95.38, 110.74]$) reported more visual details than did lies ($M = 74.40, SD = 37.34, 95\% CI [66.73, 83.98]$). The main effect of Interview was also significant, $F(1, 137) = 14.12, p < 0.001, d = 0.18$: Interviewers reported more visual details immediately after watching the video ($M = 60.74, SD = 26.90, 95\% CI [56.55, 64.93]$) than after a 2-week delay ($M = 55.98, SD = 27.17, 95\% CI [51.73, 60.22]$). The Mnemonic main effect was not significant, $F(2, 127) = 0.46, p = 0.633, \eta^2_p = 0.01$: neither was the Veracity x Interview interaction, $F(2, 127) = 0.06, p = 0.633, \eta^2_p = 0.01$: Mnemonic x Interview, $F(2, 127) = 0.30, p = 0.744, \eta^2_p = 0.004$: Mnemonic x Veracity x Interview, $F(2, 127) = 0.71, p = 0.495, \eta^2_p = 0.01$: interaction effects.

A mixed ANOVA with Veracity and Mnemonic as between-subjects factors and Interview as within-subject factor and spatial detail as the dependent variable revealed a significant main effect for Veracity, $F(1, 127) = 49.07, p < 0.001, d = 1.17$: Truth tellers ($M = 56.42, SD = 23.71, 95\% CI [51.23, 62.16]$) reported more spatial details than did lies ($M = 32.16, SD = 17.45, 95\% CI [28.43, 36.27]$).

### Table 1

<table>
<thead>
<tr>
<th>Measure</th>
<th>Truth</th>
<th>Lie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation to convince the interviewer</td>
<td>6.15</td>
<td>6.00</td>
</tr>
<tr>
<td>Preparation quality</td>
<td>5.19</td>
<td>5.05</td>
</tr>
<tr>
<td>Preparation time (s)</td>
<td>223.68</td>
<td>221.49</td>
</tr>
<tr>
<td>Stress before the interview</td>
<td>3.29</td>
<td>2.89</td>
</tr>
<tr>
<td>Confidence to convince the interviewer</td>
<td>5.42</td>
<td>4.48</td>
</tr>
<tr>
<td>Likelihood to receive £10/2 credits</td>
<td>5.21</td>
<td>4.32</td>
</tr>
<tr>
<td>Likelihood to write a statement</td>
<td>3.51</td>
<td>2.86</td>
</tr>
<tr>
<td>Times thought about the event/story</td>
<td>2.23</td>
<td>2.35</td>
</tr>
<tr>
<td>Extent of truthfulness in the immediate interview</td>
<td>99.41</td>
<td>20.02</td>
</tr>
<tr>
<td>Extent of truthfulness in the delayed interview</td>
<td>98.53</td>
<td>20.02</td>
</tr>
</tbody>
</table>

### Notes

- $p$-values are two-tailed.
- $d$-values are partial eta squared.
The main effect for Memory, F(2, 137) = 1.34, p = 0.265, $\eta^2_p = 0.02$. Interview, F(1, 137) = 0.23, p = 0.636, d = 0.02, and the Veracity × Interview interaction, F(1, 137) = 0.03, p = 0.858, $\eta^2_p = 0.00$, Memory × Interview, F(2, 137) = 0.70, p = 0.500, $\eta^2_p = 0.004$, and Veracity × Memory × Interview, F(2, 137) = 1.12, p = 0.329, $\eta^2_p = 0.02$, interaction effects were all not significant.

The same mixed ANOVA with temporal details as dependent variables revealed a significant main effect for Veracity, F(1, 137) = 92.78, p < 0.001, d = 1.56. Truth tellers reported more temporal details (M = 26.59, SD = 12.09, 95% CI [22.69, 29.58]) than did liars (M = 10.99, SD = 7.42, 95% CI [9.33, 12.63]). The Memory main effect was not significant, F(2, 137) = 0.33, p = 0.721, $\eta^2_p = 0.01$. The Veracity × Interview interaction effect was significant, F(1, 137) = 7.76, p = 0.006, $\eta^2_p = 0.05$. Truth tellers reported more temporal details in the immediate interview (M = 13.32, SD = 8.61, 95% CI [16.71, 19.94]) than in the delayed interview (M = 16.58, SD = 8.10, 95% CI [14.89, 18.27]). F(1, 144) = 8.83, p = 0.003, d = 0.21, whereas for liars, the amount of temporal information reported did not differ between the immediate (M = 7.19, SD = 4.86, 95% CI [5.61, 8.78]) and delayed interviews (M = 7.73, SD = 6.32, 95% CI [6.07, 9.99]). F(1, 141) = 0.85, p = 0.358, d = 0.10. There was also a significant Memory × Interview interaction effect, F(2, 137) = 3.79, p = 0.025, $\eta^2_p = 0.05$. Interviewees reported more temporal details in the immediate interview (M = 12.77, SD = 8.22, 95% CI [10.68, 14.83]) than in the delayed interview (M = 11.07, SD = 7.25, 95% CI [9.01, 13.13]) in the CR condition, F(1, 140) = 4.98, p = 0.027, d = 0.22, whereas the difference in the sketch condition between the immediate (M = 13.53, SD = 10.54, 95% CI [11.59, 15.47]) and delayed interview (M = 12.33, SD = 9.66, 95% CI [10.31, 14.36]). F(1, 140) = 2.50, p = 0.116, d = 0.12, and in the event-line condition between the immediate (M = 12.08, SD = 7.80, 95% CI [10.11, 14.06]) and delayed interview (M = 13.07, SD = 8.39, 95% CI [11.00, 15.13]). F(1, 140) = 1.90, p = 0.170, d = 0.12 were not significant. The Veracity × Memory × Interview interaction effect was not significant, F(2, 137) = 0.09, p = 0.941, $\eta^2_p = 0.001$.

### Table 2: Reality monitoring details in delayed free recall as a function of veracity and mnemonic condition

<table>
<thead>
<tr>
<th></th>
<th>CR</th>
<th>Sketch</th>
<th>Event-line</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Truth</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>42.58</td>
<td>70.26</td>
<td>64.52</td>
</tr>
<tr>
<td>SD</td>
<td>25.21</td>
<td>35.05</td>
<td>20.28</td>
</tr>
<tr>
<td>95% CI</td>
<td>[52.23, 79.94]</td>
<td>[59.69, 86.36]</td>
<td>[53.95, 75.10]</td>
</tr>
<tr>
<td><strong>Lie</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>49.69</td>
<td>39.81</td>
<td>41.87</td>
</tr>
<tr>
<td>SD</td>
<td>25.21</td>
<td>28.26</td>
<td>15.92</td>
</tr>
<tr>
<td>95% CI</td>
<td>[59.69, 86.36]</td>
<td>[36.51, 57.64]</td>
<td>[41.44, 47.55]</td>
</tr>
<tr>
<td>F</td>
<td>4.29</td>
<td>8.97</td>
<td>8.18</td>
</tr>
<tr>
<td>p</td>
<td>0.040</td>
<td>0.003</td>
<td>0.005</td>
</tr>
<tr>
<td>d</td>
<td>0.58</td>
<td>0.73</td>
<td>1.11</td>
</tr>
</tbody>
</table>

**Notes:** CR: control reinstatement.

A mixed ANOVA with Veracity and Memory as between-subjects factors and Interview as within-subject factor and action details as dependent variable revealed a significant main effect for Veracity, F(1, 137) = 79.09, p < 0.001, d = 1.48. Truth tellers reported more action information (M = 37.30, SD = 14.59, 95% CI [34.33, 40.26]) than did liars (M = 18.63, SD = 19.16, 95% CI [15.70, 21.54]). Interview main effect was also significant, F(1, 137) = 10.78, p = 0.001, d = 0.15. Participants reported more action details in the immediate (M = 28.93, SD = 16.16, 95% CI [26.29, 31.56]) than in the delayed interview (M = 26.55, SD = 16.23, 95% CI [23.89, 29.24]). The Memory × Interview interaction effect was also significant, F(2, 137) = 3.21, p = 0.043, $\eta^2_p = 0.05$. In the sketch condition, interviewees reported more action details in the immediate interview (M = 31.06, SD = 18.88, 95% CI [28.18, 31.43]) than in the delayed interview (M = 26.41, SD = 18.95, 95% CI [23.21, 20.99]). F(1, 140) = 14.03, p = 0.001, d = 0.25, whereas no differences emerged between the interviewers in the CR, F(1, 140) = 2.93, p = 0.089, d = 0.15, and event-line, F(1, 140) = 0.04, p = 0.852, d = 0.02, conditions. The Veracity × Interview, F(2, 137) = 2.69, p = 0.103, $\eta^2_p = 0.02$, and Veracity × Memory × Interview interaction effects, F(2, 137) = 0.12, p = 0.885, $\eta^2_p = 0.002$, were not significant.

### 4.1 Hypotheses testing

#### 4.1.1 Amount of details in the CR mnemonic

In Hypotheses 1 to 3, we predicted that in the delayed interview, specific differences between truth tellers and liars would emerge as a function of mnemonic. Table 2 shows the results. As predicted in Hypothesis 1, truth tellers reported more visual, spatial, temporal, and action details than did liars in the CR condition after a delay. All effect sizes were substantial (from 0.58 to 1.19).

In the CR condition, truth tellers reported significantly fewer temporal details in the delayed FR than in the immediate FR, F(1, 137) = 8.32, p = 0.001, d = 0.42 (for means, standard deviations, and confidence intervals, see Tables 2 and 3). For truth tellers, no
significant differences emerged between the immediate and delayed interview for visual, F(1, 137) = 2.49, p = 0.117, d = 0.36, spatial, F(1, 137) = 0.43, p = 0.515, d = 0.12, and action details, F(1, 137) = 3.42, p = 0.066, d = 0.33. Liars in the CR condition did not show a significant difference in reporting visual, F(1, 137) = 1.90, p = 0.171, d = 0.44, spatial, F(1, 137) = 0.09, p = 0.228, d = 0.09, and temporal, F(1, 137) = 0.09, p = 0.765, d = 0.09, or action details, F(1, 137) = 3.42, p = 0.066, d = 0.19, between the immediate and delayed interviews. These results partially support Hypothesis 1, in which it was predicted that in the CR condition neither truth tellers nor liars would produce a memory decline in reporting detail after a delay.

4.1.3 Amount of details in the event-line mnemonic

Truth tellers reported significantly more visual, spatial, temporal, and action details in the sketch condition, which was not predicted in Hypothesis 3. All effect sizes were substantial (from 0.73 to 1.76); see Table 2.

In the sketch condition, truth tellers reported the same amount of visual, F(1, 137) = 0.17, p = 0.680, d = 0.07, and spatial details, F(1, 137) = 0.01, p = 0.909, d = 0.02, in the immediate and delayed interviews. However, truth tellers reported less temporal, F(1, 137) = 5.72, p = 0.018, d = 0.60, and action details, F(1, 137) = 9.32, p = 0.003, d = 0.50. In the delayed interview than in the immediate interview. Liars in the sketch condition reported less visual, F(1, 137) = 4.08, p = 0.045, d = 0.30, and action details, F(1, 137) = 5.41, p = 0.022, d = 0.50, in the delayed interview than in the immediate interview. Liars showed no difference in reporting spatial, F(1, 137) = 1.47, p = 0.228, d = 0.24, and temporal details, F(1, 137) = 0.002, p = 0.968, d = 0.001, between the immediate and delayed interviews. This provides support for Hypothesis 2 in which it was predicted that in the sketch condition truth tellers, but not liars, would show memory decline in temporal and action details after a delay.

4.1.4 Consistency between the immediate and delayed interviews

A 2 x 3 (Veracity x Time) analysis of variance was conducted with nonequivalent as the dependent variable and total detail at immediate FR as a covariate. The reason for including this covariate was that the number of nonequivalents in the delayed interview depends on the amount of detail provided in the FR part of the immediate interview.
That is, the more detail provided in the immediate FR, the less opportunity to add new detail in the delayed interview. Veracity, F(1, 131) = 0.61, p = 0.437, d = 0.14, and Mnemonic, F(2, 131) = 1.50, p = 0.228, \( \eta^2_p = 0.02 \), main effects or Veracity \( \times \) Mnemonic interaction effect, F(2, 131) = 0.95, p = 0.388, \( \eta^2_p = 0.01 \), was not significant. This showed no support for Hypothesis 4.

A 2 (Veracity) \( \times \) 3 (Mnemonic) analysis of covariance with repetitions in the delayed interview as dependent variable and Total detail in the immediate FR as covariate did not result in significant main effects for Veracity, F(1, 131) = 0.71, p = 0.480, d = 0.07, and/or Mnemonic, F(2, 131) = 0.19, p = 0.831, \( \eta^2_p = 0.003 \). Although the Veracity \( \times \) Mnemonic interaction effect was significant, F(2, 131) = 4.28, p = 0.015, \( \eta^2_p = 0.06 \), simple-effect analyses showed no significant differences.

That is, in the CR condition, truth tellers provided a similar amount of repetitions (M = 100.25, SD = 43.24, 95% CI [85.60, 117.29]) to liars (M = 105.64, SD = 52.97, 95% CI [87.73, 123.26]). F(1, 43) = 0.68, p = 0.415, d = 0.12. In the sketch condition, truth tellers provided a similar amount of repetitions (M = 106.27, SD = 62.36, 95% CI [87.57, 128.29]) to liars (M = 91.64, SD = 32.27, 95% CI [76.52, 120.50]). F(1, 45) = 4.05, p = 0.05, d = 0.29; and in the event-line condition, truth tellers reported a similar amount of repetitions (M = 111.26, SD = 43.74, 95% CI [94.61, 127.94]) to liars (M = 117.29, SD = 41.20, 95% CI [96.61, 139.29]). F(1, 43) = 1.11, p = 0.297, d = 0.14.

As the number of omissions was derived from the number of total details minus number of repetitions, a 2 (Veracity) \( \times \) 3 (Mnemonic) analysis of covariance with omissions as the dependent variable and Total detail at immediate FR as covariate resulted in identical effect sizes (not significant) as in the analysis of repetitions. Thus, Hypothesis 4 was not supported.

4.2 RM details in mnemonics

A 2 (Veracity) \( \times \) 3 (Mnemonic) ANOVA with the number of visual details in the mnemonic part of the immediate interview as dependent variable revealed a significant main effect for Mnemonic, F(2, 137) = 6.88, p = 0.001, \( \eta^2_p = 0.09 \). Tukey post hoc tests showed that interviewees reported significantly more visual details in the sketch condition (M = 52.63, SD = 28.46, 95% CI [45.86, 60.41]) than in the CR condition (M = 32.68, SD = 27.45, 95% CI [25.43, 41.90]). Participants in the event-line condition (M = 46.43, SD = 26.03, 95% CI [39.90, 53.79]) also reported significantly more visual details than did participants in the CR condition. There was no significant main effect for Veracity, F(1, 137) = 2.25, p = 0.155, d = 0.22, or a significant Veracity \( \times \) Mnemonic interaction, F(2, 137) = 1.96, p = 0.145, \( \eta^2_p = 0.03 \).

A 2 (Veracity) \( \times \) 3 (Mnemonic) ANOVA with the number of spatial details in the mnemonic part of the immediate interview as dependent variable revealed a main effect for Veracity, F(1, 137) = 9.59, p = 0.002, d = 0.45. Truth tellers gave more spatial information (M = 26.87, SD = 20.53, 95% CI [22.24, 31.60]) than did liars (M = 19.00, SD = 14.04, 95% CI [15.97, 22.11]). The Mnemonic main effect was also significant, F(2, 137) = 12.10, p = 0.001, \( \eta^2_p = 0.15 \). Post hoc tests revealed that interviewees provided more spatial details in the sketch (M = 28.67, SD = 16.70, 95% CI [24.39, 32.94]) and event-line conditions (M = 25.87, SD = 19.51, 95% CI [20.58, 31.91]) than in the CR condition (M = 13.77, SD = 14.02, 95% CI [10.38, 17.50]). The Veracity \( \times \) Mnemonic interaction effect was not significant, F(2, 137) = 2.04, p = 0.051, \( \eta^2_p = 0.04 \).

A 2 (Veracity) \( \times \) 3 (Mnemonic) ANOVA with the number of temporal details in the mnemonic part of the immediate interview as dependent variable revealed a significant main effect for Veracity, F(1, 137) = 10.35, p = 0.002, d = 0.45. Truth tellers reported more temporal details (M = 10.98, SD = 11.07, 95% CI [8.16, 13.84]) than did liars (M = 6.75, SD = 7.43, 95% CI [6.01, 8.84]). In addition, the Mnemonic main effect was significant, F(2, 137) = 31.89, p < 0.001, \( \eta^2_p = 0.32 \). Post hoc tests showed that more temporal details were reported in the event-line condition (M = 16.21, SD = 9.80, 95% CI [13.29, 19.22]) than in the CR (M = 5.53, SD = 6.81, 95% CI [3.87, 7.38]) and sketch conditions (M = 4.88, SD = 7.44, 95% CI [2.98, 6.89]). The Veracity \( \times \) Mnemonic interaction effect was not significant, F(2, 137) = 2.76, p = 0.074, \( \eta^2_p = 0.04 \).

A 2 (Veracity) \( \times \) 3 (Mnemonic) ANOVA with the number of action details as dependent variable revealed a significant main effect for Veracity, F(1, 137) = 9.66, p = 0.002, d = 0.46. Truth tellers mentioned more action details (M = 21.63, SD = 21.45, 95% CI [17.21, 26.59]) than did liars (M = 13.40, SD = 13.60, 95% CI [10.33, 16.77]). The Mnemonic main effect was also significant, F(2, 137) = 20.12, p = 0.001, \( \eta^2_p = 0.23 \). Post hoc tests revealed that in the event-line (M = 29.28, SD = 17.97, 95% CI [24.31, 34.50]) condition, interviewees reported more information about actions than in the CR (M = 12.77, SD = 17.01, 95% CI [8.46, 17.68]) and sketch conditions (M = 10.53, SD = 13.98, 95% CI [7.04, 14.54]). The Veracity \( \times \) Mnemonic interaction effect was not significant, F(2, 137) = 2.21, p = 0.113, \( \eta^2_p = 0.03 \).

None of the interaction effects were significant. However, these interaction effects do not necessarily reflect the specific type of interaction we were interested in comparing the details between truth tellers and liars for these mnemonic parts of the interview separately. In alignment with Nahari and Ben-Shahar (2011) and previous deception literature (e.g., Coئ et al., 2017; Shaw et al., 2019), we believe that this justifies further examination of the data, specifically...
TABLE 4 Reality monitoring details in the different mnemonic conditions in the immediate interview.

<table>
<thead>
<tr>
<th>Detail</th>
<th>Truth M</th>
<th>SD</th>
<th>95% CI</th>
<th>Lie M</th>
<th>SD</th>
<th>95% CI</th>
<th>F</th>
<th>p</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
<td>31.29</td>
<td>28.43</td>
<td>[22.13, 41.86]</td>
<td>34.13</td>
<td>26.94</td>
<td>[24.88, 46.23]</td>
<td>0.13</td>
<td>0.720</td>
<td>0.10</td>
</tr>
<tr>
<td>Spatial</td>
<td>13.58</td>
<td>15.68</td>
<td>[8.55, 20.61]</td>
<td>13.96</td>
<td>12.40</td>
<td>[9.46, 18.46]</td>
<td>0.01</td>
<td>0.936</td>
<td>0.03</td>
</tr>
<tr>
<td>Temporal</td>
<td>5.54</td>
<td>7.62</td>
<td>[3.59, 10.39]</td>
<td>5.52</td>
<td>4.02</td>
<td>[3.41, 8.20]</td>
<td>0.00</td>
<td>0.993</td>
<td>0.002</td>
</tr>
<tr>
<td>Action</td>
<td>13.92</td>
<td>20.41</td>
<td>[6.82, 24.47]</td>
<td>11.57</td>
<td>12.90</td>
<td>[7.23, 17.67]</td>
<td>0.26</td>
<td>0.610</td>
<td>0.14</td>
</tr>
<tr>
<td>Sketch</td>
<td>54.96</td>
<td>24.46</td>
<td>[44.90, 65.87]</td>
<td>50.58</td>
<td>31.93</td>
<td>[40.66, 62.55]</td>
<td>0.32</td>
<td>0.573</td>
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</tr>
<tr>
<td>Spatial</td>
<td>30.70</td>
<td>15.47</td>
<td>[27.35, 40.03]</td>
<td>24.27</td>
<td>15.54</td>
<td>[19.99, 29.62]</td>
<td>0.42</td>
<td>0.04</td>
<td>0.61</td>
</tr>
<tr>
<td>Temporal</td>
<td>7.61</td>
<td>8.88</td>
<td>[4.05, 11.51]</td>
<td>2.42</td>
<td>4.80</td>
<td>[1.04, 4.13]</td>
<td>5.45</td>
<td>0.021</td>
<td>0.72</td>
</tr>
<tr>
<td>Action</td>
<td>14.00</td>
<td>14.26</td>
<td>[8.35, 19.82]</td>
<td>7.46</td>
<td>13.24</td>
<td>[3.48, 12.82]</td>
<td>2.10</td>
<td>0.15</td>
<td>0.48</td>
</tr>
<tr>
<td>Event-line</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual</td>
<td>56.24</td>
<td>28.25</td>
<td>[46.63, 67.20]</td>
<td>37.21</td>
<td>20.27</td>
<td>[30.11, 45.69]</td>
<td>5.40</td>
<td>0.028</td>
<td>0.77</td>
</tr>
<tr>
<td>Spatial</td>
<td>33.91</td>
<td>22.51</td>
<td>[26.00, 42.87]</td>
<td>18.17</td>
<td>12.25</td>
<td>[13.77, 23.46]</td>
<td>11.42</td>
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</tr>
<tr>
<td>Action</td>
<td>37.20</td>
<td>20.53</td>
<td>[29.63, 45.64]</td>
<td>21.58</td>
<td>10.78</td>
<td>[17.79, 25.76]</td>
<td>11.68</td>
<td>0.001</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Note: CR: context reinstatement.

5 DISCUSSION

This study examined how different mnemonic techniques employed in an immediate interview affected delayed statements. In the CR condition, truth tellers provided more visual, spatial, temporal, and action details than did liars after a delay. This finding is in line with Hypothesis 1. In addition, as predicted, liars did not show a decline in reporting details over time. Truth tellers, however, showed a decline in reporting temporal details over time, which was not expected, as it was thought that the CR mnemonic would “buffer” the truth tellers against forgetting.

In line with Hypothesis 2, in the sketch condition, truth tellers reported more visual and spatial details than did liars in the delayed accounts. In addition, truth tellers, but not liars, showed a decline in reporting temporal and action details over time. There were two findings we did not predict. First, truth tellers also reported more temporal and action details than did liars after a delay, suggesting that when the sketch technique was used, truth tellers provided richer reports in terms of all types of detail. Second, liars also showed a decline in reconstructing hypothesis (Granath & Strömwall, 1999). However, they rely to repeat their stories when interviewed repeatedly. The findings suggest that liars experienced difficulties in mimicking natural memory retrieval that should be produced by truth tellers. A sketch facilitates retrieval of visual and spatial details. Liars did not consider that if the sketch facilitates retrieval of such details, their memories for these details should be less affected than for action and temporal details after a delay (the pattern shown by truth tellers in this study).

In the event-line condition, truth tellers again reported more visual, spatial, temporal, and action details than did liars after a delay. As predicted in Hypothesis 3, truth tellers showed a decline in providing visual details, but the predicted decline in reporting spatial details did not occur. In support of Hypothesis 3, liars reported a similar amount of visual, spatial, temporal, and action details both immediately and after a delay. Again, truth tellers showed to some extent a natural decline of the details that were less prominent with the event-line technique (visual details), but liars did not consider that after a delay some details should be better remembered than others.

When considering the reporting patterns of truth tellers and liars across conditions, our study showed as a general tendency that truth tellers showed more of a decline in the amount of details reported than did liars. The truth tellers' findings are in line with memory theory that highlights a reduction in recall of information over time because of weakened memory traces (Goldsmith et al., 2005; Forndahl, 1982; Schacter, 1999). The liars' results provide evidence for a stability bias. Liars' failure to calibrate accurately their verbal output to take into account genuine decline in memory (Harvey et al., 2017).

With regard to consistency between the immediate and delayed statements, we found no differences in consistency between truth tellers and liars, and Hypothesis 4 was therefore rejected. In alignment with previous research (Granath & Strömwall, 2002; Vrevestvedt et al., Granath et al., 2016) but in contrast to the widely held stereotypical view (Biagiard, 2016), our study showed that truth tellers and liars can be equally consistent in their statements.

Although our study concentrated on comparisons between immediate and delayed accounts, we also reported comparisons between the initial and mnemonic parts of the immediate interview. In brief,
we found that participants in the CR mnemonic performed the worst in eliciting additional detail, and the event-line mnemonic the best. Also, in terms of the ability to discriminate between truth tellers and liars, the CR mnemonic was the least, and the event-line was the most effective mnemonic. Perhaps the event-line mnemonic was the most effective in eliciting information and in distinguishing between truth tellers and liars because the stimulus event (break-in) was dynamic. The entire 5 min video was full of different activities, and in such a situation, the event-line technique might be very helpful for truth tellers in facilitating recall of actions and events, and their temporal order. Liers typically experience an information management dilemma (Granhag & Hartvig, 2008). They are typically motivated to report some information, but not too much. This dilemma might exist even when mnemonics are used in interviews.

The differences between truth tellers and liars were substantial (i.e., effect sizes were high) across all conditions. Our findings thus revealed that the richness of detail verbal cue remains a diagnostic cue to deceit, even after longer delay periods. This is a novel finding compared with previous studies that showed that truth tellers’ and liars’ accounts became similar over time (Harvey et al., 2017; Vrij et al., 2009). The important difference between these studies and our current study is that in those studies participants were interviewed only once, either immediately or after the delay, whereas in the current study, they were interviewed twice. Perhaps the immediate interview in truth tellers served as a buffer for forgetting in the delayed interview. The use of mnemonics in the immediate interview may have further strengthened this buffer effect.

The findings have important practical implications. First of all, they suggest that using mnemonic techniques during the first interview is helpful in terms of information gathering during subsequent interviews with the interviewee. Furthermore, using mnemonic techniques during the first interview can aid discriminating between truth tellers and liars in subsequent interviews.

5.1 Methodological considerations and future research

The main methodological consideration in our study might be that it did not contain a “no mnemonic” control group, which makes it impossible to determine whether the mere presence of a mnemonic has influenced the delayed reports of truth tellers and liars. However, our main concern was to examine how different mnemonics would affect the reports of truth tellers and liars over time. Further deception studies might profit from examining separate mnemonics (e.g., event-line) and compare them to the performance of a no mnemonic control group.

Research has shown that an immediate retrieval task tends to strengthen episodic memory and facilitate later retrieval (Bjork, 1968; Roediger & Karpicke, 2006; Shaw, Björk, & Handal, 1995). Therefore, truth tellers in our study could maintain rich accounts after a delay due to immediate retrieval practice, but not as a result of specific mnemonic techniques per se. In further studies, it would be valuable to examine truth tellers’ and liars’ performances when a first statement is not given immediately, but after some delay, and how mnemonic techniques then affect first and subsequent statements.

In real-life cases, this situation occurs frequently. Further studies could use scenarios with active involvement of participants, rather than passively watching a video as we did in this study. Using a video has a benefit of exerting complete experimental control with all participants witnessing exactly the same event. However, this benefit comes at the expense of ecological validity.

6 CONCLUSION

This study showed that when mnemonics were used during the immediate interview, the verbal cue richness of detail remained a diagnostic cue to deceit even after a delay. In addition, truth tellers more often than liars showed a decline in reporting details after a delay. Truth tellers showed patterns of reporting indicative of genuine memory decay, whereas liars showed patterns of “stability bias,” a failure to accurately estimate memory decay (Harvey et al., 2017). Overall, the findings indicate that mnemonic techniques such as the CR, a sketch, or event-line in a first interview are promising tools to deception detection in subsequent interviews.

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