The Effect of Embedded Lies on the Verbal Quality of Statements and Implications for Credibility Assessment

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General Abstract

Embedded lies, the topic of investigation in this thesis, have been under researched within the deception detection literature. The overarching aim of this research was to examine how interviewees' strategic inclusion of both truths and lies within a single account may affect statement quality, and the subsequent implications for verbal lie detection.

Across three experimental studies and one exploratory survey, I (i) explored the deception strategies reported by people who claim to be good liars (Chapter 2), (ii) examined how the combination of truths and lies within a single account affects the verbal quality of statements (Chapters 3 and 4), and (iii) tested if embedded lies can be exploited to facilitate within-statement lie detection (Chapter 5). **Chapter 2** (n = 194) explored deception by investigating how laypeople's self-reported ability to deceive was associated with their lie frequency, characteristics, and deception strategies. Of particular interest was whether the strategic inclusion of truthful details into lies corresponded to higher perceptions of deception ability. Results showed that self-reported good liars reported embedding lies as their most common strategy for deceiving successfully. **Chapter 3** (n = 144), experimentally tested how interviewees strategically regulate the information they provide when their accounts contain both truthful and deceptive information. Results showed that interviewees calibrated the richness of detail provided in the first element of their statement to be consistent with the veracity of the second element, such that elements followed by a lie were less detailed than elements followed by a truth. Further examination revealed that participants also calibrated their lies according to both the preceding and the following element, with lies becoming more detailed when they were flanked by truthful information compared to when they were flanked by other lies. In light of these results,

Chapter 4 (*n* = 111) examined whether embedded lies differed qualitatively from full fabrications. The results showed that the two types of lies did not differ on a number of content-based cues (e.g., detail richness), but that lies embedded in otherwise truthful statements could be distinguished from truths embedded in truthful statements on the basis of detail richness and statement quality (i.e., clarity and plausibility). Finally, **Chapter 5** (*n* = 148) tested whether lie detection accuracy could be improved by using embedded lies as a within-statement baseline comparison. Contrary to the hypothesis, results showed that instructing participants to make a within-statement baseline comparison did not increase the accuracy of their veracity assessments.

Taking the results of these studies together, it could be concluded that liars aim to strategically maintain consistency regarding the quality of information provided between truths and lies within their statements; however, content-based methods of verbal credibility assessment based on the cues measured in this research appear to be robust against this strategy. The results of this thesis emphasise that lie detectors should exploit liars' attempts at maintaining consistency by utilising methods of verbal baselining that control for both the individual and the situation.

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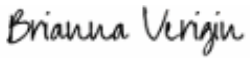
Declaration

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 for any other academic award.



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Abbreviations

MS……...Model Statement

RM……...……...…….Reality Monitoring

ANOVA…….Analysis of variance

VA……..Verifiability Approach

OSF……Open Science Framework

mTurk……Amazon Mechanical Turk

CBCA……..Criteria-Based Content Analysis

ICC……...Intra-class Correlation Coefficient

BF_{01}…….....Bayes factor, expressed as evidence in support of null hypothesis

BF_{10}……..Bayes factor, expressed as evidence in support of alternative hypothesis

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Dissemination

Publications

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Chapter 1:
Introduction to the thesis

1.1 Introduction

The main focus of this doctoral thesis was to investigate how the strategic embedding of lies influences the verbal behaviours of liars. In this chapter, I will broadly introduce the importance of studying deception detection for investigative purposes. Subsequently, I will discuss the theoretical foundations of verbal deception detection, emphasising the memory-based and strategy-based origins of several prominent verbal cues to deception. My discussion will also extend to the strategies of lying and truth-telling interviewees wherein I will highlight the strategy of embedding lies, an often-neglected aspect of deception research. From here, I will put forward the aims of the present research: (i) to explore the deception strategies of good liars, (ii) to examine the extent to which truthful and deceptive information interact to influence verbal quality, and (iii) to test whether embedded lies can be exploited to facilitate within-statement lie detection. Finally, the research conducted to address these aims will be described.

1.1.1 Importance of Studying Deception

Determining the credibility of an interviewee, be it a suspect, victim or witness, is a fundamental component of the investigative process. It is therefore not surprising that the scientific study of deception has already spanned over a century (Münsterberg, 1908). Indeed, several hundred studies have measured people's ability to distinguish between truthful and deceptive accounts. The most robust finding in this literature is that humans are poor lie detectors, accurately detecting lies at rates barely exceeding chance level (e.g., Bond & DePaulo, 2006; Levine, 2010; Vrij, 2008a). This finding also holds true for professionals whose job it is to make judgements of credibility, such as police officers (e.g., Bond & DePaulo, 2006; Hartwig, Granhag, Strömwall, & Vrij, 2004; Luke et al., 2016).

One of the explanations for the poor lie detection performance is an overreliance on behavioural cues. No single behaviour, nor group of behaviours, is systematically and reliably indicative of deception (DePaulo et al., 2003; Hartwig & Bond, 2011; Wright & Wheatcroft, 2017), yet people continue to base their judgements on stereotypical nonverbal cues such as gaze aversion (Bogaard, Meijer, Vrij, & Merckelbach, 2016; Strömwall, Granhag, & Hartwig, 2004).

1.1.2 Verbal Lie Detection

The most diagnostic information is found in the content of liars' speech. The accuracy of credibility assessments improves when judgements are based only on the verbal content of a statement (52% correct lie-truth classifications) versus through visual mediums (63% correct classifications; Bond & DePaulo, 2006). In fact, a review of over thirty studies showed that when observers' judgements were guided by statement analysis, their accuracy rates increased to 72% (Vrij, 2005). Additionally, good lie detectors report a higher reliance on verbal cues when making credibility judgments, whereas poor lie detectors tend to rely primarily on non-verbal cues (Mann, Vrij, & Bull, 2004). It has therefore been advocated that for lie detection purposes, both in research and practice, it is more valuable to listen carefully to what interviewees say than to observe their nonverbal behaviour (Vrij, 2008b).

One of the most consistent findings in the verbal lie detection literature is that liars' statements are typically less richly detailed than those of their truth-telling counterparts (e.g., Amado, Arce, Fariña, & Vilarino, 2016; DePaulo et al., 2003; Luke, 2019). In fact, the estimated effect size of quantity of details is $d = 0.55$ (Amado et al., 2016), which is remarkably high for the social sciences (Funder & Ozer, 2019; Richard, Bond, & Stokes-Zoota, 2003). Additionally, meta-analytical findings support the usefulness of temporal, visual, and auditory details for differentiating truthful from false accounts

(Masip, Sporer, Garrido, & Herrero, 2005). Based on these types of variables, the accuracy rate of classifying truth-tellers and liars extends well beyond chance level (Masip et al., 2005; Vrij, Fisher, & Blank, 2017).

1.1.2.1 Memory-based cues to deception. The use of content-based details as cues to deception stems from memory research. In particular, two commonly used methods of verbal credibility assessment have their foundations in theories of memory. Reality Monitoring (RM; Johnson & Raye, 1981) posits that memories derived from real experiences differ in quality from memories based on imagination, due to differences in the cognitive processes involved in externally versus internally generated memories. RM suggests that memories of real events are acquired through perceptual processes and therefore are more likely to contain details relating to sensory, spatial, temporal, and affective information, and to be generally more clear, sharp and vivid, compared to imagined events. Similarly, Criteria-Based Content Analysis (CBCA; Steller & Köhnken, 1989) is based on the hypothesis that memories of personally experienced events differ in both quality (e.g., the logical structure or plausibility) and content (e.g., unexpected complications) to memories of fabricated or imagined accounts (Undeutsch, 1967, 1989). These tools, in particular CBCA, are extensively used in forensic practice (e.g., Amado et al., 2016). Moreover, research supports these theoretical rationales within lie detection contexts: Liars lack the memory traces truth-tellers have, leaving them unable to provide as many rich details as honest individuals (Masip et al., 2005; Oberlader et al., 2016; Vrij, 2008). Though not without criticism, (see Masip et al., 2005; Vrij, 2005), CBCA and RM are favourable tools as, with appropriate training, evaluators' accuracy rates increase from chance level to 65% - 80% (Vrij, 2008a).

1.1.2.2 Strategy-based cues to deception. More recently, scholars have developed deception detection techniques that aim to exploit interviewees' strategies for appearing credible. One example is the Verifiability Approach (VA; Nahari, Vrij, & Fisher, 2014a, 2014b). The VA works on the assumption that liars, on the one hand, are inclined to provide detailed statements to be perceived as cooperative and credible, but, on the other hand, want to minimise the chances that investigators can falsify their statement (Masip & Herrero, 2013; Nahari et al., 2014a). A strategy that meets these contradictory aims is to provide information that cannot be verified.

Another example of a deception detection measure that is sensitive to the verbal strategies of liars and truth-tellers relates to common knowledge details (i.e., strongly invoked stereotypical information about events; Vrij, Leal, Mann et al., 2017). Whereas truth-tellers have personal, unique experiences of an event (DePaulo, Kashy, Kirkendol, Wyer, & Epstein, 1996), liars typically lack such information and their reports tend to be characterised by more general, impersonal knowledge (Sporer, 2016). Liars also tend to report fewer complications – occurrences that make a situation more difficult than necessary, often characterised by disrupted activity or failing efforts (e.g., missing the bus; Steller & Köhnken, 1989; Vrij, Leal, Jupe, & Harvey, 2018) – compared to truth-tellers. This makes sense given liars' preference for simple stories (Hartwig et al., 2007). An additional strategy-based measure relates to self-handicapping strategies (i.e., justifications as to why someone is unable to provide certain information; Vrij, Leal, Mann et al., 2017). Liars are motivated to keep their stories simple; however, they also realise that admitting a lack of knowledge and/or memory may generate suspicion from investigators (Ruby & Brigham, 1998). A strategic solution then is to provide a justification for the failure to provide information. Taking these three cues together, investigators can calculate the

proportion of complications (complications / complications + common knowledge details + self-handicapping strategies), which represents the proportion of cues to truthfulness. This proportion score has theoretical advantages given that it is a within-subjects comparison that is also sensitive to the different verbal strategies used by liars and truth-tellers (Vrij, Leal, Jupe, & Harvey, 2018).

1.1.3 Liars' and Truth-Tellers' Strategies

Strategy-based deception detection techniques derive from a larger body of research on interviewees' counter-interrogation strategies. This work is premised on the idea that it may be possible to identify more reliable deception cues, and potentially improve lie-detectors' ability to discriminate between liars and truth-tellers, by improving our understanding of how liars and truth-tellers try to tell a convincing story (e.g., Clemens, 2013). The fact that individuals, guilty or innocent, adopt particular strategies in their attempts to appear credible can be explained by the theory of self-regulation: A social cognitive framework for understanding how people control their behaviour to move away from undesired outcomes and to reach desired goals (Carver & Scheier, 2012; Clemens, Granhag, & Strömwall, 2013; Fiske & Taylor, 2008; Hartwig, Granhag, & Luke, 2014). In legal contexts, this translates to a common goal among liars and truth-tellers, who both aim to convince the interviewer of their credibility. Importantly, the information management strategies by which they attempt to reach this goal will differ, largely due to differences in the mental state of liars and truth-tellers (Hartwig, Granhag, Strömwall, & Doering, 2010).

1.1.3.1 Embedded lies. One strategy that may contribute to liars' success is the embedding of lies into truthful information. Embedded lies can be defined as fragments of deceptive information integrated into truthful stories designed to mislead an investigator. When given the opportunity, liars will incorporate such embedded lies

into their accounts. Evidence for the prevalence of embedded lies comes from Leins, Fisher, and Ross (2013). In two studies, these authors found that the majority of liars – 67% in the first study and 86% in the second – chose to formulate their deceptive account based on a previously experienced event. Additionally, in their study evaluating the verifiability approach, Nahari et al. (2014b) found that of their 44 mock criminals who were instructed to provide deceptive statements, more than half indicated that over 20% of their statement was truthful. Further evidence comes from Hartwig and colleagues' (2007) examination of guilty and innocent suspects' strategies, which revealed that one of liars' most endorsed strategies was to avoid lying by telling the truth as much as possible. In fact, liars will generally provide as much experienced or truthful information as possible, to the extent that they do not incriminate themselves (Nahari & Vrij, 2015). The use of embedded lies has been observed across various populations, such as research participants (Bell & DePaulo, 1996; Leins, Zimmerman, & Polander, 2017), non-criminals engaging in deception (DePaulo et al., 2003), and even criminal suspects (Strömwall & Willén, 2011). It has been speculated that this strategy can enhance one's credibility because lies of this type may be easier to deliver and more difficult for interviewers to detect, as compared to outright lies (Vrij, 2008a).

1.1.4 New Research Directions

Nearly all research to date treats deception as dichotomous. That is, statements are classified as either truthful or deceptive, and participants as either liars or truth-tellers. This division is reflected in hypotheses, designs and experimental procedures (e.g., McCornack, Morrison, Paik, Wisner, & Zhu, 2014). Indeed, some researchers have acknowledged that liars prefer to embed lies into otherwise truthful statements (e.g., Leins et al., 2013; Nahari 2018a; Nahari & Vrij, 2015; Vrij, 2008a; Vrij,

Granhag, & Porter, 2010), though this has mostly been in the form of disclaimers within discussion sections. Few have explicitly acknowledged, nor systematically manipulated, the inclusion of both truthful and deceptive information within statements. Doing so would more accurately reflect real-world conditions in which suspects interweave truths and lies (e.g., Leins et al., 2017; Strömwall & Willén, 2011; Vrij, 2008a).

There is variation in the extent to which deceptive information can be integrated into truthful stories. For instance, an arsonist who denies having set a fire yesterday can instead claim that he visited the gym. He can then describe an entirely truthful recollection of a previous visit to the gym, lying only about the day and time at which the visit occurred. It is also possible that liars embed more elaborate descriptions of deceptive events into their statements. For example, when providing an alibi statement, a burglar could report the majority of his day truthfully, but could lie about his activities during the window of time during which he committed the burglary. This latter type of embedded lie, whereby liars integrate descriptions of deceptive events into otherwise truthful stories, is the focus of the current dissertation.

As it stands, we are largely unaware how such embedded lies may affect the verbal content of statements and subsequently, what implications this may have for verbal lie detection tools. This thesis aimed to address these gaps. My objectives were threefold. First, I aimed to advance our understanding of liars' deception strategies, particularly those that help self-reported good liars evade detection. Second, I aimed to narrow in on how the strategic embedding of lies may affect statement quality. Third, I aimed to work towards a within-statement method for exploiting embedded lies to improve deception detection ability. These lines of inquiry are both highly warranted and long overdue, and will provide critical insights for credibility assessors

in both research and practice. What follows is a list of topics directly related to the scope of this thesis that warrant further investigation.

1.1.4.1 Good liars. An interesting feature of the empirical literature on lie detection is that most studies have focused either on strategies and cues designed to improve discriminatory accuracy, or individual differences in lie detection ability (Vrij & Granhag, 2012). A growing body of evidence, however, indicates that the accuracy of detecting deception depends more on the skill or characteristics of the deceiver and less on the judges' lie detection ability (Bond & DePaulo, 2008; Bond, Kahler, & Paolicelli, 1985; Law et al., 2018; Levine, 2016; Levine et al., 2011). Even so, only a handful of studies have attempted to determine individual differences in the ability to lie credibly (e.g., DePaulo & Rosenthal, 1979; Riggio, Tucker, & Throckmorton, 1987; Vrij, Granhag, & Mann, 2010; Wright, Berry & Bird, 2012, 2013). Little is known about what constitutes good liars, or what causes the variation in detectability. Some research, for example, has shown that sender demeanor explained up to 98% of the variance in detection accuracy (Levine et al., 2011). Other researchers have speculated that good liars use effective strategies to conduct their behaviour, by attempting to act in line with people's beliefs about how truth-tellers behave while avoiding behaviour associated with liars (Vrij, Granhag, & Mann, 2010). Still, this field is in its infancy and additional research on what characterises those who escape detection (i.e., good liars) would be highly beneficial in investigative settings. In particular, digging deeper into good liars' strategies could aid in the development of strategy-based interventions targeted at these individuals, who may be more likely to avoid detection.

1.1.4.2 Embedded lies and the effect on statement quality. Research on beliefs about cues to deception and liars' strategies suggests that the embedding of lies could affect their quality. Laypeople and legal professionals alike believe that

inconsistency is symptomatic of deception (Blair, Reimer, & Levine, 2018; Vredeveldt, van Koppen, & Granhag, 2014; Strömwall & Granhag, 2003). Accordingly, one of the main concerns of liars – and one of their most frequently reported strategies – is to maintain consistency (Deeb, Vrij, Hope, Mann, Granhag, & Lancaster, 2017; Hartwig, Granhag, Strömwall, & Doering, 2010). Moreover, liars tend to be more concerned with reducing the amount of within-statement inconsistency (i.e., inconsistencies between details within a single statement) than any other type of inconsistency, such as between-statement inconsistency (i.e., the level of consistency between different statements made by the same suspect) or statement-evidence inconsistency (i.e., the level of consistency between the suspect's statement and the other evidence; Deeb et al., 2017, 2018). In one of the only studies to include statements that purposefully contained both truths and lies, Deeb et al. (2017) instructed liars to provide a statement containing reports about two events, one deceptive and the other truthful, during two interviews. When asked about their strategies for appearing credible, 45% of liars mentioned maintaining consistency for both events between statements. Moreover, many liars reported that they did so by strategically lowering their "baseline consistency" by including fewer repetitions when they reported truthfully to match the number of repetitions provided during their deceptive report. A plausible explanation is that liars do not want the deceptive component of their story to stand out from the remainder of their statement, as that would draw attention to their lies. Thus, if interviewees embed their lies in an otherwise truthful statement, their efforts to maintain consistency may also extend to the quality of details provided between the truthful and deceptive parts of their statement.

If liars are able to successfully maintain consistency regarding the quality of details provided between the lies and truths of their statement, it could mean that lies become, for example, more richly detailed when surrounded by truths. Embedded lies that are characterised by high-quality contextual and perceptual details could jeopardise the diagnostic accuracy and utility of verbal credibility assessment tools such as CBCA and RM, that are premised upon differences in the content of accounts based on experienced versus non-experienced events (e.g., Masip et al., 2005; Vrij, 2005; Vrij, Granhag, & Porter, 2010). This could be particularly problematic in investigative contexts given that guilty suspects who strategically embed their lies may go undetected by these tools.

Despite concerns, little research has addressed how lies that are embedded into truthful accounts may differ from lies that are completely fabricated. One study that included comparisons between partially deceptive and truthful mock suspects found that partially deceptive statements had fewer details and were less coherent than truthful statements (Porter & Yuille, 1996). The authors speculated that the act of lying affected the quality and quantity of information provided, as opposed to the memories themselves. In fact, even when liars and truth-tellers carry out the same activities (but for either malevolent or benevolent reasons), verbal differences still occur with liars reporting their activities in less detail than truth-tellers (Vrij, Mann, Jundi, Hillman, & Hope, 2014). Additionally, research by Palena and colleagues (2018) required interviewees to tell the truth about one theme (event) but to lie about another, during one interview. Their results showed that truth-tellers reported the same amount of information about both themes, whereas liars reported fewer details for the theme they lied about compared to the theme they reported truthfully.

Few previous studies have also examined how lies differ when they are invented or based on past experiences, and to what extent this influences verbal lie detection tools. For instance, one previous study found that the content of liars' and truth-tellers' statements differed on RM criteria even when past experiences were used, but that RM was most effective when liars invented their stories rather than using previous experiences (Gnisci, Caso & Vrij, 2010). Similar results were also found in unpublished work by Valois and colleagues (2019). These authors examined whether CBCA and RM techniques could differentiate both fully and partially deceptive accounts from truthful accounts, finding that both tools were still effective even when interviewees incorporated truthful events into fabricated accounts. Given the scarcity of work on this topic, further research is warranted to understand the effects of embedded lies on statement quality and the subsequent consequences for the reliability of verbal credibility assessment tools. Such research could inform both researchers and practitioners whether or not the commonly used methods of credibility assessment (e.g., CBCA and RM) are robust against the embedding of deceptive events into otherwise truthful stories.

1.1.4.3 Within-statement lie detection. On the one hand, embedded lies may pose a risk to the reliability of verbal credibility assessment tools, but on the other hand, lie detectors may be able to exploit these lies to benefit deception detection. One way to do so is by using the baseline technique. Baselining refers to the practice in which interviewers evaluate the veracity of a critical component of a statement relative to a baseline, or neutral, component of the interview (see Vrij, 2016 for an overview), and is reportedly used by some police in practice (Ewens, Vrij, Jang, & Jo, 2014; Frank, Yarbrough, & Ekman, 2006; Inbau et al., 2013; U.S. Department of the Army, 2006). Previous research on baselining shows that to enhance diagnostic accuracy, the

baseline statement must be equivalent to the statement of interest in terms of content, time-frame, stakes, cognitive and emotional involvement, and questioning context (i.e., a comparable truth baseline; Caso, Palena, Vrij, & Gnisci, 2019; Ewens et al., 2014; Palena, Vrij, Caso, & Orthey, 2018). Moreover, a comparable truth baseline can enhance truth-lie discrimination accuracy (e.g., Caso et al., 2019). It is also possible that, if portions of an interviewee's statement can be verified as truthful, embedded lies could provide an opportunity for a within-statement baseline comparison. Investigators could theoretically derive a baseline statement from parts of an interviewee's statement to successfully increase deception accuracy. This would have important implications for practitioners who may be inclined to draw such comparisons between corroborated and uncorroborated portions of an interviewee's account. Within-statement comparisons also facilitate veracity decisions at the individual level, thereby overcoming common criticisms of deception research relating to generalisations of group-derived estimates to individual cases (e.g., Fisher, Medaglia, & Jeronimus, 2018). It is therefore unsurprising that researchers and practitioners alike have called for more research of this type (e.g., Vrij, 2016).

1.2 The Current Thesis

This PhD thesis provides an empirical examination of embedded lies, with the aim of answering three central questions: (i) which strategies do people who claim to be good liars report using to successfully evade detection, (ii) to what extent do embedded lies affect the verbal quality of statements, and (iii) can embedded lies be exploited to facilitate lie detection? To answer these questions, a mixed-methodological approach was taken. Chapter 2 reports survey research examining the deception strategies of good liars, whereas Chapters 3, 4 and 5 contain experimental research testing the impact of embedded lies on the verbal quality of statements and

the potential for exploiting embedded lies using a within-statement lie detection approach. Additionally, in the general discussion (Chapter 6), an overview of the key findings is presented, followed by the theoretical and practical implications of my results for credibility assessments in academic and applied contexts. The studies are summarised in further detail below.

Chapter 2 (Study I). Surveying liars as a source of insight into real-world deception remains an underdeveloped research avenue (e.g., Nahari et al., 2019). I conducted an international survey to explore the association between laypeople's self-reported ability to deceive and their lie frequency, characteristics, and deception strategies in daily life. I replicated the previous finding that a minority of individuals account for the majority of lies, and I found evidence that these prolific liars also consider themselves good liars. Additionally, my results showed that self-reported good liars attempt to strategically manipulate their verbal behaviour to embed lies within truthful information and to tell plausible, simple, and clear stories. This study highlights the importance of developing strategy-based interventions that account for the strategic embedding of lies, particularly by skilled liars.

Chapter 3 (Study II). Although it has been acknowledged that liars prefer to embed lies into otherwise truthful statements, there is a scarcity of research on how truthful and deceptive information may interact within statements. I experimentally tested how interviewees strategically regulate the information they provide when their accounts contain both truths and lies. The findings of this study suggest that interviewees calibrate the richness of detail provided in the first element of their statement based on the veracity of the following element, with elements followed by a lie being less detailed than elements followed by a truth. I also found that lies become more detailed when they are flanked by truthful information compared to when they are

flanked by other lies, meaning that participants also calibrated their lies according to both the preceding and the following element. Liars' strategic calibration of the detail richness of the truthful and deceptive components of their statements provides reason to believe that embedded lies could threaten the reliability of verbal credibility assessment tools.

Chapter 4 (Study III). The extent to which embedded lies hinder the effectiveness of verbal credibility tools is largely unknown. In this study, I extended my paradigm to incorporate lies that were embedded into truthful information, to examine whether lies that were embedded into truthful stories were qualitatively different than lies that were part of entirely fabricated statements. Results showed that embedded lies did not differ from full fabrications in terms of, for example, detail richness and the verifiability of information, but that embedded lies could be distinguished from truthful statements based on detail richness and statement quality (i.e., clarity and plausibility). Based on the findings of this study, verbal credibility assessment tools based on the verbal content measured in this study appear to be robust against the embedding of lies.

Chapter 5 (Study IV). Finally, I tested whether embedded lies could be exploited as a within-statement baseline comparison to facilitate lie detection. Participants read a mock suspect's alibi statement and provided a veracity judgement regarding a critical two-hour period within the statement. This critical element was either deceptive or truthful and was embedded into an otherwise truthful story. Half of the participants received additional instructions to use to the surrounding truthful elements of the statement as a baseline. Contrary to my prediction, I found that instructing participants to make a within-statement baseline comparison did not

improve the accuracy of deception detection. These results have applied relevance given police officers' potential reliance on similar techniques during investigations.

Chapter 2: Lie prevalence, lie characteristics and strategies of self-reported good liars

This chapter draws from the following manuscript:

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2.1 Abstract

Meta-analytic findings indicate that the success of unmasking a deceptive interaction relies more on the performance of the liar than on that of the lie detector. Despite this finding, the lie characteristics and strategies of deception that enable good liars to evade detection are largely unknown. I conducted a survey (n = 194) to explore the association between laypeople's self-reported ability to deceive on the one hand, and their lie prevalence, characteristics, and deception strategies in daily life on the other. Higher self-reported ratings of deception ability were positively correlated with self-reports of telling more lies per day, telling inconsequential lies, lying to colleagues and friends, and communicating lies via face-to-face interactions. Results also showed that self-reported good liars highly relied on verbal strategies of deception and they most commonly reported to i) embed their lies into truthful information, ii) keep the statement clear and simple, and iii) provide a plausible account. This study provides a starting point for future research exploring the meta-cognitions and patterns of skilled liars who may be more likely to evade detection.

2.2 Introduction

Despite the importance of being able to detect deception, research has consistently found that people are unable to do so. In fact, the accuracy rates vary around chance level (e.g., Bond & DePaulo, 2006; Vrij, 2008). Lacking good lie detectors, a growing body of evidence indicates that the accuracy of detecting deception depends more on the characteristics of the deceiver and less on the lie detection ability of the judge (Bond & DePaulo, 2008; Bond, Kahler, & Paolicelli, 1985; Law et al., 2018; Levine, 2016; Levine et al., 2011). The meta-analysis of Bond and DePaulo (2008) provided robust evidence that liars vary in their detectability. Their analysis showed that differences in detectability from sender to sender are more reliable than differences in credulity from judge to judge, with reliability coefficients of .58 and .30, respectively. This pattern of results was replicated by Law et al. (2018), lending support to the proposition that liar characteristics exert a powerful influence on lie detection outcomes. Moreover, Levine et al. (2011) showed that sender demeanour explained up to 98% of the variance in detection accuracy.

Despite the above, only a handful of studies have attempted to determine individual differences in the ability to lie credibly (e.g., DePaulo & Rosenthal, 1979; Riggio, Tucker, & Throckmorton, 1987; Vrij, Granhag, & Mann, 2010; Wright, Berry & Bird, 2012, 2013). Research on what characterises those who escape detection (i.e., good liars) would be highly beneficial in investigative settings. Thus, a focus on the liar, in particular the skilled liar, was the aim of this study. Specifically, the present chapter reports an exploratory study addressing how self-reported deception ability is associated with lie prevalence and lie characteristics, and how self-reported good liars utilise strategies for deceiving.

First, the relationship between liars' self-reported lie-telling frequency and self-reported deception ability was investigated. The most widely cited research on deception prevalence estimates the frequency at an average of once or twice per day (DePaulo, Kashy, Kirkendol, Wyer, & Epstein, 1996; see also George & Robb, 2008). More recent research, however, shows that the distribution of lies per day is considerably skewed. The majority of lies are told by only a handful of prolific liars (Serota & Levine, 2015; Serota, Levine, & Boster, 2010; Halevy, Shalvi, & Verschuere, 2014). Specifically, Serota and Levine (2015) showed that in almost 3,000 participants, 5% of people accounted for over 50% of all the lies reported within the past 24 hours, whereas the majority of subjects reported telling no lies at all. Several additional studies, as well as a reanalysis of the DePaulo et al.'s (1996) diary study, have validated that the majority of lies are told by a minority of people (e.g., George & Robb, 2008; Serota et al., 2010). These few prolific liars tend to tell more serious lies that carry significant consequences if detected (Serota & Levine, 2015). Also, people who self-reported to lie more often were more prone to cheating in laboratory tasks for personal profit (Halevy et al., 2014). It is possible that these prolific liars also perceive themselves as more skilled at deceiving and tell more lies that they think will stay undetected, either because they believe the target will not try to find out or they believe they are good enough to fool the target.

Second, this investigation examined whether characteristics of lies differ as a function of self-reported deception ability. The first of these characteristics is the type of lie. This can refer to the severity; at one end are white lies, which are relatively common (Feldman, Forrest, & Happ, 2002) and often used to ease social interactions (e.g., telling your mother-in-law that her baking is delicious when you actually dislike sweets; Vrij, 2007), while at the other end are bold-faced fabrications, which are less

common and typically serve to protect the liar (e.g., denying having had an affair; Craig, 2003). The latter type of lies are also encountered more by the legal system (Vrij, Edward, Roberts, & Bull, 2000). Other variations of lies also exist, for example lies of omission or lies embedded into the truth; however, research has yet to explore how the types of lies could differ as a function of deception ability. Is it that, for example, good liars tend to utilise a certain type of lie which facilitates their success? The second characteristic is the receiver of the lie. Lies can be communicated to a variety of individuals ranging from family, romantic partners, and friends to strangers, colleagues, or authority figures. Previous research has shown that people lie less frequently in close relationships than in casual relationships (DePaulo & Kashy, 1998). A third characteristic of interest is the medium of deception, as this can also influence the success of one's lie. Some liars, for instance, prefer online communication (Van Swol, Braun, & Kolb, 2015). This would fit the liars' (erroneous) belief that their deception will leak out via behavioural cues (Vrij, Granhag, & Porter, 2010). It is unknown, however, if or how good liars concentrate their lies to specific individuals or communicate via certain mediums.

Finally, I examined the strategies that self-reported good liars utilise for successfully deceiving. The idea that liars adopt strategies to enhance the likelihood of successfully deceiving stems from research on impression and information management. Both forms of regulation relate to the idea that much of social behaviour is controlled for the purpose of interpersonal presentation (DePaulo, 1992; DePaulo et al., 2003). In legal contexts, both liars and truth-tellers are motivated to achieve a favourable impression and attempt to do so by regulating their speech and behaviour, albeit liars more so than truth-tellers (e.g., Hartwig, Granhag, & Strömwall, 2007). The topic of deceivers' strategies has received some empirical attention (e.g., Colwell,

Hiscock-Anisman, Memon, Woods, & Michlik, 2006; Hartwig et al., 2007; Hartwig, Granhag, Strömwall, & Doering, 2010; Strömwall, Hartwig, & Granhag, 2006). For example, it was found that among the principal strategies of criminal offenders were "Staying close to the truth," and "Not giving away information" (Strömwall, & Willén, 2011). Researchers have also capitalised on this increased awareness of liars' and truth-tellers' strategies by developing strategy-based lie detection tools. For instance, the Verifiability Approach (VA; Nahari, Vrij, & Fisher, 2014a, 2014b) exploits liars' strategy of providing detailed statements that are embellished with unverifiable information. Still, surveying expert liars as a source of insight into real-world deception remains a highly underdeveloped research avenue (e.g., Nahari et al., 2019).

The purpose of this survey was to shed light on the association between self-reported deception ability and lie prevalence and lie characteristics. Given the exploratory nature of this research objective, a-priori hypotheses were not specified.

2.3 Method

2.3.1 Participants

The sample consisted of 194 participants (97 females; 95 males; 2 preferred not to say; M_{age} = 39.12 years, SD_{age} = 11.43) recruited via Amazon Mechanical Turk (mTurk). Most participants reported being U.S. citizens (n = 175), whereas the remainder (n = 19) reported Indian citizenship. Participants who completed the study were paid 1.75 USD. Participants could participate in the study if they reported to be able to understand and write English at an advanced level. To ensure data quality, participants were required to have the mTurk Masters Qualification that is awarded to those who have demonstrated continual excellence across a wide range of mTurk projects. An additional 133 participants began the questionnaire but did not complete it, therefore their data were discarded. Data from nine participants were also removed

because of insufficient responses. The sample size (n = 194) was reached after these exclusions. The study was approved by the standing ethical committee.

2.3.2 Procedure

The online questionnaire was created on Qualtrics online platform. After providing informed consent, participants were provided definitions of lying and deception modelled from previous research (DePaulo et al., 1996; Vrij, 2008a; see Appendix A). Participants were asked to read these definitions carefully and to consider them while making responses throughout the questionnaire. In the first part of the questionnaire, participants reported their experience with telling lies in daily life. Participants reported the estimated number of lies told during the past 24 hours. Participants then responded to multiple-response questions about i) the types of lies told during the past 24 hours (options: white lies, exaggerations, lies of omission/concealment, lies of commission/fabrications, embedded lies; see Appendix A for the definitions provided to participants); ii) the receivers of their deception (options: family, friend, employer, colleague, authority figure, or other); and iii) the mediums of their deception (options: face-to-face, over the phone, social media, text message, email, or other). Participants also rated on a 10-point Likert scale (1 – very poor to 10 – excellent) "How good are you at successfully deceiving others (i.e., getting away with lies)?"

The second part of the questionnaire probed the deceivers' strategies. Participants provided an open-ended response to explain "In general, what strategy or strategies do you use when telling lies?" They were then asked to rate on a 10-point Likert scale (1 – not important to 10 – very important) how important they consider verbal strategies of deception and nonverbal strategies of deception to be for getting away with lies (for the definitions provided to participants, see Appendix A). Finally,

participants indicated which verbal strategies they use when telling lies in general from a predetermined set (options: reporting from previous experience, providing details the person cannot check [i.e., unverifiable details], telling a plausible story, etcetera). The options included in this list were drawn from empirical findings regarding liars' strategies and cues to deception (e.g., DePaulo et al., 2003; Leins, Fisher, & Ross, 2013; Nahari et al., 2014a)[1]. After rating the predetermined set of strategies, participants were unable to modify their previous open-ended responses. Participants then provided demographic information regarding their age, sex, citizenship, ethnicity and education.[2]

Qualitative analysis. To code the participants' self-reported strategies into data-driven categories, the Principal Investigator performed a content analysis on the open-ended responses to the question probing their use of strategies. First, each participant's strategy or strategies was identified, then all overlapping responses were combined, and these strategies were condensed into several dominant categories with theoretical similarities (i.e., relating to behavioural control or verbal control, etcetera). The Principal Investigator completed each stage of this process and the other members of the research team verified the final decisions by confirming the conceptual basis for each category. Seven categories emerged from this coding method, for example omitting certain information, relating to truthful information, or controlling behaviour (see Table 2.1).

To establish inter-rater reliability, the Principal Investigator, who has expertise with qualitative coding, extensively trained a Research Assistant. Both individuals then

[1] Given the theme of this doctoral research, I was particularly interested in how liars might maintain consistency in their statements if they chose to interweave lies and truths. To tease apart how individuals could manipulate their statements to maintain consistency, I included two categories related to the strategic matching of the type and amount of details between lies and truths within statements.
[2] An additional section of the questionnaire probed laypeople's opinions on the types of lies and strategies used by guilty and innocent suspects in an investigative context. Given the conceptual differences, this section was retained for use in a separate manuscript beyond this thesis.

coded a randomly selected 20% of the participants' open-ended responses into the appropriate categories. A two-way mixed effects model measuring consistency (e.g., Koo & Li, 2016) showed that coders were highly consistent across all categories (Single Measures *ICCs* ranged from .79 to 1.00). After confirming that the coders were consistent, the Principal Investigator completed the remaining sample of participant responses and only these scores were used in the analysis.

2.4 Results

This survey sought to i) replicate previous findings regarding the distribution skewness of lie-telling frequency; ii) isolate lie characteristics as a function of deception ability; and iii) explore the strategies of deception used by self-reported good liars.

2.4.1 Lie Prevalence and Characteristics

First, I investigated how laypeople lie in daily life by examining the frequency of lies, types of lies, receivers and mediums of deception within the past 24 hours. Overall, participants indicated telling a mean of 1.61 lies during the last 24 hours (*SD* = 2.75; range: 0-20 lies), but the distribution was non-normally distributed, with a skewness of 3.90 (*SE* = 0.18) and a kurtosis of 18.44 (*SE* = 0.35). The six most prolific liars, less than 1% of the participants, accounted for 38.5% of the lies told. Thirty-nine percent of the participants reported telling no lies. Figure 2.1 displays participants' lie-telling prevalence.

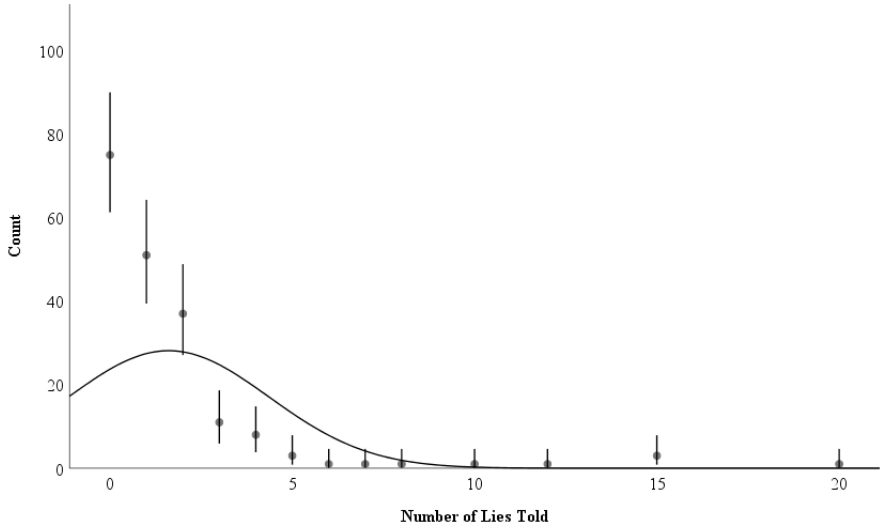


Figure 2.1. Scatterplot of participants' self-reported lie-telling frequency during the past 24 hours. The distribution curve represents the mean and standard deviation of the total sample. Error bars represent 95% confidence intervals.

I also explored participants' endorsement of the type, recipient, and medium of their lies (see Figure 2.2). Participants mostly reported telling white lies, to family members, and via face-to-face interactions. All lie characteristics displayed non-normal distributions.

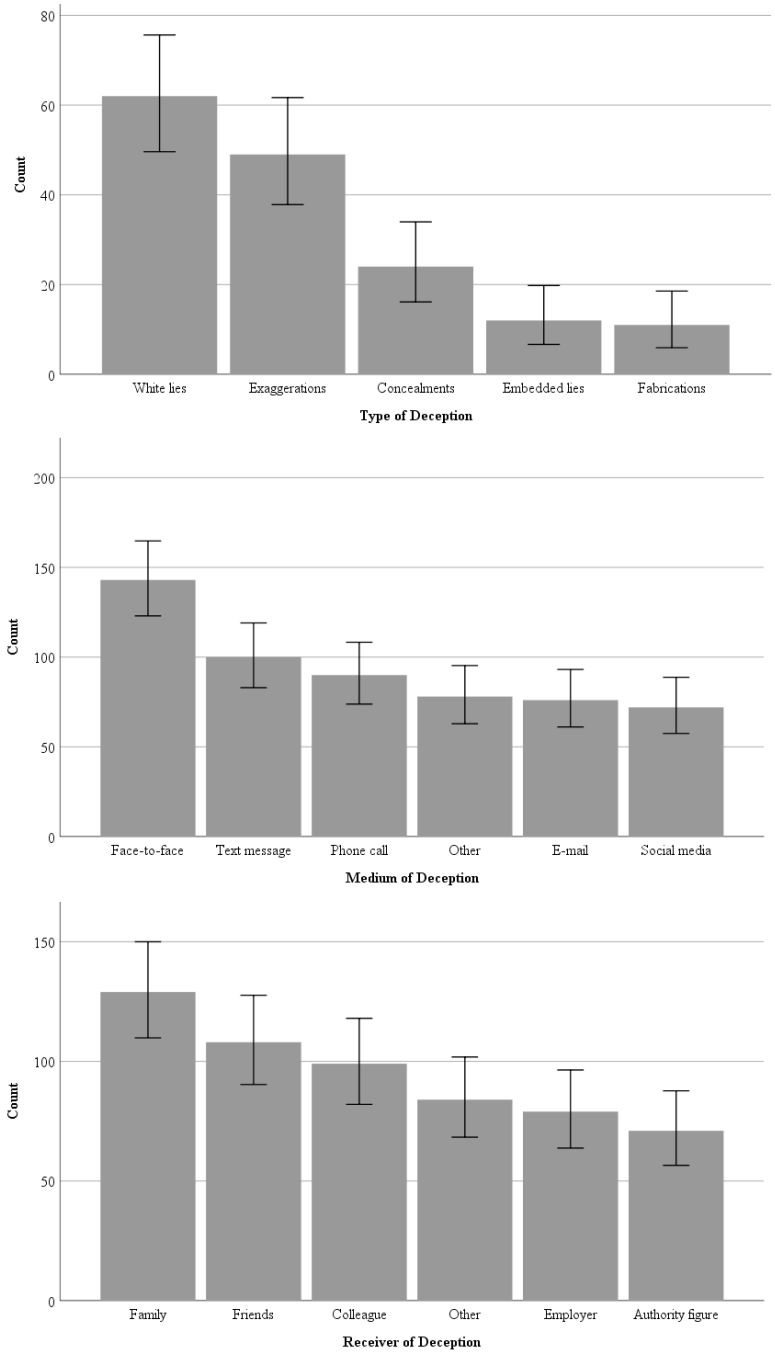


Figure 2.2. Bar charts displaying the frequency of the types, receivers, and mediums of deception endorsed by participants for their reported lies during the past 24 hours. Error bars represent 95% confidence intervals. For deception recipients, "other" refers to individuals such as intimate partners or strangers; for deception mediums, "other" refers to online platforms not included in the provided list.

Lie prevalence and characteristics as a function of deception ability. Next, correlational analyses were conducted to examine the association of participants' lie frequency and characteristics with their self-reported deception ability. An increase in

self-reported ability to deceive was positively correlated to a greater frequency of lies told per day, $r(192) = .22$, $p = .002$, and with higher endorsement of telling white lies and exaggerations within the last 24 hours ($r(192) = .16$, $p = .023$ and $r(192) = .16$, $p = .027$, respectively). There were no significant associations between self-reported deception ability and reported use of embedded lies, $r(192) = .14$, $p = .051$; lies of omission, $r(192) = .10$, $p = .171$; or lies of commission, $r(192) = .10$, $p = .161$. Higher self-reported deception ability was significantly associated with telling lies to colleagues, $r(192) = .27$, $p < .001$, friends, $r(192) = .16$, $p = .026$, and "other" receivers of deception, $r(192) = .16$, $p = .031$; however, there were no significant associations between self-reported ability to lie and telling lies to family, employers, or authority figures ($r(192) = .08$, $p = .243$; $r(192) = .04$, $p = .558$; and $r(192) = .11$, $p = .133$, respectively). Finally, higher values for self-reported deception ability were positively correlated to telling lies via face-to-face interactions, $r(192) = .26$, $p < .001$. All other mediums of communicating the deception were not associated with a higher reported ability, as follows: Via phone conversations, text messaging, social media, email, or "other" sources ($r(192) = .13$, $p = .075$; $r(192) = .13$, $p = .083$; $r(192) = .03$, $p = .664$; $r(192) = .05$, $p = .484$; $r(192) = .10$, $p = .153$, respectively).

2.4.2 Deception Strategies of Self-Reported Good Liars[3]

I was also interested in exploring the strategies of deception, particularly those of good liars. To test this, categories representing participants' self-reported deception ability were created, using their scores from the question asking about their ability to deceive successfully, as follows: Scores of three and below were combined into the category of "Poor liars" ($n = 51$); scores of 4, 5, 6, and 7 were combined into the

[3] Please note that the deception ability of liars was analysed in two ways, first as a continuous score to allow for more statistically powerful (correlational) analyses, and second as a categorical variable to allow for analysis of variance (ANOVA) testing.

category of "Neutral liars" (n = 75); and scores of eight and above were combined into the category of "Good liars" (n = 68).

Table 2.1 provides an overview of the exact values regarding the endorsement of each deception strategy that emerged from the qualitative coding. To examine whether there were associations between the reported strategies and varying deception abilities, a series of chi square tests of independence were conducted on participants' coded responses to the question regarding their general strategies for deceiving. No statistically significant associations were observed between self-reported deception ability and the endorsement of any strategy categories (see Table 2.1), apart from one exception. There was a significant association between Poor, Neutral and Good liars and the endorsement of using "*No strategy"*. Pairwise comparisons were performed using Dunn's (1964) procedure with a corrected alpha level of .025 for multiple tests. This analysis revealed a significant difference in endorsing *"No strategy"* only between the Good and Poor liars, p = .004. However, the assumption of all expected cell frequencies being equal to or greater than five was not met and as such these data may be skewed. Based on Cohen's (1988) guidelines, all associations were small to moderate (all Cramer's *Vs* < .206).

Table 2.1

Endorsement of general qualitative deception strategies and descriptive statistics as a function of deception ability

Interview Strategies	*N*	*M*	*SD*	X^2
Omitting certain information	76	0.39	0.49	$\chi^2(2) = 3.00$, $p = .223$, $V = .124$
Poor liars	25	0.49	0.51	
Neutral liars	**28**	**0.37**	**0.49**	
Good liars	23	0.34	0.48	
Providing certain information	49	0.25	0.44	$\chi^2(2) = 5.49$, $p = .064$, $V = .168$
Poor liars	7	0.14	0.35	
Neutral liars	20	0.27	0.45	

Good liars	**22**	**0.32**	**0.47**	
Relating to truthful information	49	0.25	0.44	$\chi^2(2) = 5.02$, $p = .081$, $V = .161$
Poor liars	7	0.14	0.35	
Neutral liars	**23**	**0.31**	**0.46**	
Good liars	19	0.28	0.45	
Behavioural control	39	0.20	0.40	$\chi^2(2) = 2.69$, $p = .260$, $V = .118$
Poor liars	9	0.18	0.39	
Neutral liars	12	0.16	0.37	
Good liars	**18**	**0.26**	**0.44**	
Miscellaneous strategies	44	0.23	0.42	$\chi^2(2) = 1.29$, $p = .524$, $V = .082$
Poor liars	9	0.18	0.39	
Neutral liars	17	0.23	0.42	
Good liars	**18**	**0.26**	**0.44**	
No strategy	10	0.05	0.22	$\chi^2(2) = 8.26$, $p = .016$, $V = .206$
Poor liars	**6**	**0.12**	**0.33**	
Neutral liars	4	0.05	0.23	
Good liars	0	0	0	
Not Applicable	15	0.08	0.27	$\chi^2(2) = 1.23$, $p = .540$, $V = .080$
Poor liars	4	0.08	0.27	
Neutral liars	4	0.05	0.23	
Good liars	**7**	**0.10**	**0.31**	

Note. The *N* column represents the number of participants who endorsed each strategy, both in the total sample and for Poor, Neutral and Good liars, respectively. The total number of endorsed strategies surpasses the sample size of 194 because each participant could report multiple strategies that may have fallen into more than one category. Higher mean values indicate a more frequent endorsement of the respective strategy, whereas lower mean values indicate a less frequent endorsement of the respective strategy. The bolded numbers represent the group with the highest endorsement of each strategy.

Verbal and nonverbal strategies. To investigate whether participants differed in their endorsement of the importance of verbal versus nonverbal strategies based on their self-reported deception ability, two between-subjects ANOVAs were conducted with deception ability (Poor, Neutral, Good) on participants' Likert scale ratings of the general importance of verbal and nonverbal strategies. Additionally, the data were

examined by calculating Bayesian ANOVAs with default prior scales, using JASP software. The Bayesian factors (*BF*; for interpretation, see Jarosz & Wiley, 2014; Lee & Wagenmakers, 2013) are reported in line with the guidelines by Jarosz and Wiley (2014), adjusted from Jeffreys (1961). For ease of interpretation, BF_{10} is used to indicate the Bayes factor as evidence in favour of the alternative hypothesis, whereas BF_{01} is used to indicate the Bayes factor as evidence in favour of the null hypothesis.

First, there was a significant effect of self-reported deception ability on participants' endorsement of the importance of verbal strategies, $F(2, 191) = 5.62$, $p = .004$, $\eta_P^2 = .056$; $BF_{10} = 7.11$. Post hoc comparisons indicated that Good liars rated verbal strategies as significantly more important than Neutral liars ($M_{diff} = -0.82$, 95% CI [-1.47, -0.18], $p = .009$), and Poor liars ($M_{diff} = -0.83$, 95% CI [-1.54, -0.11], $p = .018$). Participants across deception ability groups did not differ with respect to their endorsement of the importance of nonverbal strategies, $F(2, 191) = .003$, $p = .997$, $\eta_P^2 < .001$; $BF_{01} = 18.55$.

Next, the specific verbal strategies participants reported to use when lying were examined. Participants were asked to indicate, from a list of ten options, which strategies they use. Table 2.2 provides an overview of the strategies endorsed by Poor, Neutral, and Good liars. Across all groups, the most frequently reported strategies were "*Keeping the statement clear and simple*" (endorsed by 17.6% of participants), "*Telling a plausible story"* (15.1% of participants), *"Using avoidance/being vague about details"* (13.2% of participants) and *"Embedding the lie into an otherwise truthful story"* (13.1% of participants). To examine differences in the endorsement of each of the predetermined verbal strategies across Poor, Neutral, and Good liars, a series of one-way between-subjects ANOVAs were conducted. Significant differences emerged for eight of the strategies, as follows: "*Embedding the lie," F*(2, 191) = 11.97, $p < .001$,

η_P^2 = .111; BF_{10} = 1438.20; *"Matching the amount of details in the deceptive component of the statement to the truthful component,"* $F(2, 191) = 4.77$, $p = .010$, $\eta_P^2 = .048$; $BF_{10} = 3.32$; *"Matching the type of details of the deceptive component of the statement to the truthful component,"* $F(2, 191) = 3.56$, $p = .030$, $\eta_P^2 = .036$; $BF_{10} = 1.15$; *"Keeping the statement clear and simple,"* $F(2, 191) = 5.07$, $p = .007$, $\eta_P^2 = .050$; $BF_{10} = 4.15$; *"Telling a plausible story,"* $F(2, 191) = 5.48$, $p = .005$, $\eta_P^2 = .054$; $BF_{10} = 5.98$; *"Providing unverifiable details,"* $F(2, 191) = 4.95$, $p = .008$, $\eta_P^2 = .049$; $BF_{10} = 3.78$, and "*Avoidance,"* $F(2, 191) = 3.79$, $p = .024$, $\eta_P^2 = .038$; $BF_{10} = 1.43$. Interestingly, Good liars reported using all of the above strategies significantly more than Poor liars (all *p's* < .025). The only exception was that Poor liars reported using the avoidance strategy significantly more than Good liars ($p = .026$). Finally, there were no significant differences between Good, Neutral, and Poor liars in endorsing *"Reporting from previous experience/memory"* ($F(2, 191) = 1.32$, $p = .268$, $\eta_P^2 = .014$; $BF_{01} = 5.96$), *"Using complete fabrication"* ($F(2, 191) = 0.57$, $p = .565$, $\eta_P^2 = .006$; $BF_{01} = 11.36$), and *"Using other strategies"* ($F(2, 191) = 0.51$, $p = .600$, $\eta_P^2 = .005$; $BF_{01} = 11.96$). See Table 2.2 for the exact values and applicable post hoc comparisons.

Table 2.2

Endorsement of predetermined deception strategies and descriptive statistics as a function of deception ability

Interview Strategies	*N*	*M*	*SD*	Bonferroni Comparisons	
				Poor	Neutral
Keeping the statement clear and simple	112				
Poor liars	20	0.39	0.49		
Neutral liars	49	0.65	0.48	**.010**	
Good liars	43	0.63	0.49	**.025**	1.00
Telling a plausible story	96				
Poor liars	17	0.33	0.48		
Neutral liars	36	0.48	0.50	.302	
Good liars	43	0.63	0.49	**.004**	.195

Avoidance	84				
Poor liars	28	0.55	0.50		
Neutral liars	35	0.47	0.50	1.00	
Good liars	21	0.31	0.47	**.026**	.167
Embedding the lie	83				
Poor liars	13	0.26	0.44		
Neutral liars	26	0.35	0.48	.850	
Good liars	44	0.65	0.48	**< .001**	**< .001**
Providing unverifiable details	76				
Poor liars	12	0.24	0.43		
Neutral liars	29	0.39	0.49	.251	
Good liars	35	0.52	0.50	**.006**	.338
Matching the *type* of details between lies and truths	71				
Poor liars	12	0.24	0.43		
Neutral liars	27	0.36	0.48	.453	
Good liars	32	0.47	0.50	**.025**	.503
Reporting from previous experience	55				
Poor liars	10	0.20	0.40		
Neutral liars	23	0.31	0.46	.535	
Good liars	22	0.32	0.47	.387	1.00
Matching the *amount* of details between lies and truths	38				
Poor liars	5	0.10	0.30		
Neutral liars	12	0.16	0.37	1.00	
Good liars	21	0.31	0.47	**.012**	.072
Using complete fabrication	14				
Poor liars	2	0.04	0.20		
Neutral liars	6	0.08	0.27	1.00	
Good liars	6	0.09	0.29	.930	1.00
Using other strategies	7				
Poor liars	3	0.06	0.24		
Neutral liars	2	0.03	0.16	1.00	
Good liars	2	0.03	0.17	1.00	1.00

Note. The *N* represents the number of participants who endorsed each strategy per group. Post hoc comparisons were conducted with the Bonferroni correction, and the *p*-values are displayed in the table. Higher mean values indicate a more frequent endorsement of the respective strategy, whereas lower mean values indicate a less

frequent endorsement of the respective strategy. The bolded numbers represent the significant cell comparisons.

2.5 Discussion

The results showed that self-reported good liars i) may be responsible for a disproportionate amount of lies in daily life, ii) tend to tell inconsequential lies, mostly to colleagues and friends, and generally via face-to-face interactions, and iii) highly rely on verbal strategies of deception, most commonly reporting to embed their lies into truthful information, and to keep the statement clear, simple and plausible.

Lie Prevalence and Characteristics

First, I replicated the finding that people lie, on average, once or twice per day, including its skewed distribution. Nearly 40% of all lies were reported by a few prolific liars. Furthermore, higher self-reported ratings of individuals' deception ability were positively correlated with self-reports of: i) telling a greater number of lies per day, ii) telling a higher frequency of white lies and exaggerations, iii) telling the majority of lies to colleagues and friends or others such as romantic partners, and iv) telling the majority of lies via face-to-face interactions. Importantly, skewed distributions were also observed for the other lie characteristics, suggesting that it may be misleading to draw conclusions from sample means, given that this does not reflect the lying behaviours of the average person. A noteworthy finding is that prolific liars also considered themselves to be good liars.

The finding that individuals who consider themselves good liars report mostly telling inconsequential lies is somewhat surprising. This deviates from the results of a previous study, which showed that prolific liars reported telling significantly more serious lies, as well as more inconsequential lies, compared to everyday liars (Serota & Levine, 2015). However, small, white lies are generally more common (e.g., Feldman et al., 2002) and people who believe they can get away with such minor falsehoods may

be more inclined to include them frequently in daily interactions. It is also possible that self-reported good liars in this sample had inflated perceptions of their own deception ability because they tell only trivial lies versus lies of serious consequence.

Regarding the other lie-characteristics, a positive correlation was found between self-reported deception ability and telling lies to colleagues, friends and others (e.g., romantic partners). This variation suggests that good liars are perhaps less restricted in who they lie to, relative to other liars who tell more lies to casual acquaintances and strangers than to family and friends (e.g., DePaulo & Kashy, 1998). The results also showed that good liars tended to prefer telling lies face-to-face. This fits the findings of one of the only other studies to examine characteristics of self-reported good versus poor liars, which found that self-perceived good liars most commonly lied via face-to-face interactions versus through text chat (Van Swol & Paik, 2017). This could be a strategic decision to deceive someone to their face, since people may expect more deception via online environments (e.g., Whitty & Carville, 2008). As researchers continue to examine the nature of lying and to search for ways of effectively detecting deception, it is important to recognise how certain lie characteristics may influence individuals' detectability as liars.

Deception Strategies

I also isolated the lie-telling strategies of self-reported good liars. People who identified as good liars placed a higher value on verbal strategies for successfully deceiving. Additional inspection of the verbal strategies reported by good liars showed that commonly reported strategies were embedding lies into truthful information and keeping their statements clear, simple and plausible. In fact, good liars were more likely than poor liars to endorse using these strategies, as well as matching the amount and type of details in their lies to the truthful part/s of their story, and providing unverifiable

details. A common theme among these strategies is the relation to truthful information. This fits with the findings of previous literature, that liars typically aim to provide as much experienced information as possible, to the extent that they do not incriminate themselves (e.g., Leins et al., 2013; Nahari & Vrij, 2015). Additionally, good liars used plausibility as a strategy for succeeding with their lies. This reflects the findings of the meta-analysis by Hartwig and Bond (2011) that implausibility is one of the most robust correlates of deception judgements, and the results of DePaulo et al. (2003) that one of the strongest cues to deception is liars' tendency to sound less plausible than truth-tellers (d = -0.23).

I also found that self-reported poor liars were more likely than good liars to rely on the avoidance strategy (i.e., being intentionally vague or avoiding mentioning certain details). Previous research suggests that this is one of the most common strategies used by guilty suspects during investigative interviews (Granhag & Hartwig, 2008). Additionally, all liars in this study expressed behavioural strategies as being important for deceiving successfully. This could be explained by the widespread misconceptions about the associations between lying and behaviour, for example that gaze aversion, increased movement or sweating are behaviours symptomatic of deception (e.g., Bogaard, Meijer, Vrij, & Merckelbach, 2016; Vrij, 2008).

There was inconsistency in the data between the responses to the qualitative strategy question and the multiple-response strategy question. Based on the qualitative strategy data it seems that Good, Neutral, and Poor liars do not differ in their use of strategies. However, robust differences emerged when participants' endorsement of the predetermined strategies was evaluated. One explanation for this finding is that the task of generating deception strategies was too demanding for participants and they were unable to articulate their tactics, whereas it was a simpler task to select strategies from

a provided list. Ericsson and Simon (1980) suggest that inconsistencies can occur when asking participants to make retrospective judgements about their behaviour. This is particularly likely when the question posed is too vague to elicit the appropriate information, which might have been the case in this study. It could also be that the results from the multiple-response strategy question were the effect of inattentive or careless responding by participants, since selecting items from a list is a simple task (e.g., Meade & Craig, 2012). Future research should continue exploring the deception strategies of good liars using a variety of methodological approaches.

2.5.1 Limitations and Future Research

Some methodological considerations should be addressed. First, the results of the present study are drawn from participants' self-reports about their patterns of deception in daily life. Sources of error associated with such self-report data limit the ability to draw strong inferences from this study. For example, there may have been socially desirable responding or underreporting within the survey, given that lying is often perceived as a taboo behaviour. However, previous research has validated the use of self-report to measure lying prevalence by correlating self-reported lying with other measures of dishonesty (Halevy et al., 2014). Moreover, self-report data may not be as untrustworthy as critics argue, and in some situations, it may be the most appropriate methodology (Chan, 2009). This study was intended as an initial examination of the strategies and preferences of good liars, and surveying liars for their own perspectives provided a novel source of insight into their behaviour. A constraint to the generalisability of this research is that this survey did not establish the ground truth as to whether self-reported good liars are indeed skilled deceivers. Future research could attempt to extend these findings by examining deceivers' lie frequency, characteristics, and strategies after testing their lie-telling ability within a controlled laboratory setting.

Second, one of the most frequent concerns about using Amazon MTurk relates to low compensation and resulting motivation (e.g., Landers & Behrend, 2015). I took measures to ensure that the remuneration to participants was above the fair price for comparable experiments. Importantly, data collected through MTurk produces equivalent results as data collected from online and student samples (Casler, Nickel, & Hackett, 2013; Feitosa, Joseph, & Newman, 2015; Landers & Behrend, 2015). It speaks to the validity of these data, for example, that the self-reported prevalence of lies, and the endorsement of nonverbal deception strategies, replicates previous research.

2.5.2 Conclusion

In sum, this study yields new insights into the deception prevalence, characteristics, and strategies used by self-reported good liars. I replicated the finding that a minority of individuals account for the majority of lies told in daily life, and I provide evidence that these prolific liars also consider themselves good liars. I unveiled several lie characteristics of good liars: They lean towards telling inconsequential lies, mostly to colleagues and friends, and generally via face-to-face interactions. Additionally, the results showed that self-reported good liars may attempt to strategically manipulate their verbal behaviour to stay close to the truth and to tell a plausible, simple, and clear story. This study provides a starting point for further research on the meta-cognitions and patterns of skilled liars who may be more likely to evade detection in investigative settings.

Chapter 3: The interaction of truthful and deceptive information

This chapter draws from the following manuscript:

Verigin, B. L., Meijer, E. H., Vrij, A., & Zauzig, L. (2019). The interaction of truthful and deceptive information. *Psychology, Crime and Law.* doi: 10.1080/1068316X.2019.1669596

3.1 Abstract

Research consistently shows that truthful accounts are richer in detail than deceptive accounts. It is unknown, however, how interviewees strategically regulate the information they provide when their accounts contain both truthful and deceptive information. This study examined how truths and lies interact, and whether interviewees' self-reported strategies reflect such interactions. Participants (n = 144) provided one statement consisting of two elements. The veracity of these elements was manipulated, with participants allocated to either both truthful, both deceptive, or one truthful and the other deceptive conditions. Results indicated that interviewees calibrate the richness of detail provided in the first element of their statement based on the veracity of the following element. Moreover, the exploratory tests revealed that lies become more detailed when they are flanked by truthful information relative to when they are flanked by other deceptive information. The finding that truthful and deceptive information interacts to influence detail richness provides insight into liars' strategic manipulation of information when statements contain a mixture of truths and lies. Strategic manipulations of this kind could potentially threaten the reliability of commonly used verbal lie detection tools. This study also offers insight to legal practitioners who rely on baseline deviations to assess credibility.

3.2 Introduction

In the legal arena, ascertaining the credibility of an interviewee remains an integral component of the investigative process. However, credibility assessment is a challenging task. Decades of research indicate that humans are poor lie detectors, rarely achieving accuracy rates above chance level (Bond & DePaulo, 2006). One of the explanations for the poor lie detection performance is an overreliance on behavioural cues. No single behaviour, nor group of behaviours, is systematically and reliably indicative of deception (DePaulo et al., 2003; Hartwig & Bond, 2011; Wright & Wheatcroft, 2017), yet people continue to base their judgements on non-diagnostic behavioural cues such as gaze aversion or fidgeting (Bogaard, Meijer, Vrij, & Merckelbach, 2016; Strömwall, Granhag, & Hartwig, 2004).

Research regarding verbal deception detection is more promising. A stable finding within the literature is that liars' statements contain significantly fewer details than truth-tellers' statements (Amado, Arce, Fariña, & Vilarino, 2016; DePaulo et al., 2003; Vrij, 2008a). More specifically, liars' statements contain less perceptual, spatial, and temporal details than truth-tellers' statements (Vrij, 2008a, 2008b). Much of these findings stem from research on Criteria-Based Content Analysis (CBCA; Steller & Köhnken, 1989) and Reality Monitoring (RM; Alonso-Quecuty, 1992, 1995; Johnson, Bush, & Mitchell, 1998; Johnson & Raye, 1981). Both CBCA and RM assume that recollections of personally experienced events are more detailed and coherent than statements about unexperienced or fabricated events (Johnson & Raye, 1981; Undeutsch, 1967, 1989; Vrij, 2005, 2008a) because memories of external origin (i.e., truthful reports) are based on perceptual processes whereas memories of internal origin (i.e., deceptive reports) are based on individuals' imagination and reasoning. In particular, it can be reasoned that truths represent experienced memories and are more

likely to include perceptual, contextual and affective information and to be more clear and plausible than lies, which are based on imagination (Johnson & Raye, 1981).

Statements often consist of a mixture of both truths and lies. When given the opportunity, liars will incorporate their deception into descriptions of previous experiences, so called embedded lies. Evidence for the prevalence of embedded lies comes from Leins, Fisher, and Ross (2013). In two studies, these authors found that the majority of liars – 67% in the first study and 86% in the second – chose to formulate their deceptive account based on a previously experienced event. Additionally, Nahari et al. (2014) found that of their 44 mock criminals who were instructed to provide deceptive statements, more than half indicated that over 20% of their statement was truthful. The use of embedded lies has been observed across various populations, whether it is research participants (Bell & DePaulo, 1996; Leins, Zimmerman, & Polander, 2017), non-criminals engaging in deception (DePaulo et al., 2003), or criminal suspects (Hartwig, Granhag, & Strömwall, 2007).

The embedding of lies into otherwise truthful statements is also reflected in the findings from research examining the strategies interviewees adopt to appear credible (Clemens, Granhag, & Strömwall, 2013; Fiske & Taylor, 2008). For example, Hartwig and colleagues' (2007) examination of guilty and innocent suspects' strategies revealed that one of liars' most endorsed strategies was to avoid lying by telling the truth as much as possible. Interviewees' strategic attempts to be perceived as credible can be explained by the theory of self-regulation, a framework for understanding how people are motivated to control their behaviour to move away from undesired outcomes and to reach desired goals (Carver & Scheier, 2012; Hartwig, Granhag, & Luke, 2014). Liars strategically attempt to edit reality to create a plausible, logical story (Granhag, Strömwall, & Jonsson, 2003; Vrij, Granhag, & Mann, 2010) that may have its

foundations in truthful previous experiences. In contrast, innocent interviewees are generally forthcoming and aim to provide full, candid accounts (Hartwig et al., 2007) using their memory to reconstruct what happened.

In the present study, I investigated to what extent truthful and deceptive information interacts to influence detail richness. The rationale for expecting truths and lies to interact is based on research into beliefs about cues to deception. Several studies have shown that people believe inconsistencies are a sign of deception (Blair, Reimer, & Levine, 2018; Vredeveldt, van Koppen, & Granhag, 2014). Consequently, it is not surprising that liars report to try to maintain consistency as a strategy to appear credible. In general, liars tend to be most concerned with reducing the amount of inconsistencies within the details of their statement compared to any other type of inconsistency (e.g., between-statement or statement-evidence inconsistencies; Deeb et al., 2017, 2018). As a result of their efforts to maintain consistency, liars tend to be equally or more consistent than truth-tellers (Granhag & Strömwall, 2002; Granhag et al., 2003; Vredeveldt et al., 2014), who – as a normal function of memory – may appear inconsistent as information is naturally added or forgotten (e.g., Fisher, Brewer, & Mitchel, 2009).

In one of the only studies to include statements that purposefully contained both truths and lies, Deeb et al. (2017) instructed liars to provide a statement containing reports of a deceptive event and a truthful event during two interviews. When asked about their strategies for appearing credible, nearly half of the liars (45%) reported an attempt to maintain consistency across the interviews for both events. Moreover, many liars reported that they did so by strategically lowering their "baseline consistency" by including fewer repetitions in non-critical portions of the interview. In contrast, only 8% of truth-tellers reported using the consistency strategy (Deeb et al., 2017). Given

liars' focus on consistency, it is plausible that when their statements contain both truthful and deceptive information their efforts to maintain consistency may extend to the richness of information provided.

In sum, lies are rarely complete fabrications. Yet, this is often how they are treated in research (Vrij, 2008a), leaving a significant gap within the deception literature. Examination of statements consisting of both truths and lies could account for individual differences in deceiving (see Vrij, 2016) and provide insight into liars' verbal behaviour. As such, the objective of the current experiment was twofold. First, I extended the findings of Deeb et al. (2017) to examine how truths and lies interact to influence the consistency of detail richness across elements of a statement. Second, I examined to what extent such interactions are reflected in deceivers' self-reported strategies. To examine this, the participants in this study provided a statement consisting of two elements. I manipulated the veracity of these elements, with participants either delivering both truthful, both deceptive, or one truthful and the other deceptive element. Based on the general verbal deception literature, I predicted that truthful elements would be richer in detail than deceptive elements (Hypothesis 1). There are two ways in which participants could maintain consistency. First, by calibrating the content of the second element of their statement to that of the first element. This would imply that elements *preceded* by a lie would be less detailed than elements *preceded* by a truth (Hypothesis 2). Second, it is also possible that participants would anticipate the second element, and calibrate the content of the first element to that of the second. The next prediction was therefore that elements *followed* by a lie would be less detailed than those *followed* by a truth (Hypothesis 3). Finally, the interaction between lies and truths was expected to be, at least in part, reflected in the participants' self-reported strategies (Hypothesis 4).

3.3 Method

3.3.1 Participants

The sample consisted of 144 native-German speaking undergraduate students (116 females; 28 males) who participated in exchange for either course credit or a €7.50 voucher. Participants described their ethnicity as Caucasian (n = 116), Asian (n = 5), Hispanic (n = 2), or 'Other' (n = 21). A-priori power analysis suggested that to achieve an 85% likelihood of detecting a true difference given a medium effect size (f = .25; Cohen, 1988), 146 participants were required. To allow for an equal distribution across conditions, 144 participants were recruited. All participants were between 18 and 26 years old (M = 20.81, SD = 1.70), and had not yet received any information on lie-detection or interviewing techniques in their curriculum. The study was approved by the standing ethical committee.

3.3.2 Design

The present study used a 2 (Veracity of the first element [truth, lie]) by 2 (Veracity of the second element [truth, lie]) between-subjects factorial design. The primary dependent measure was the richness of detail (i.e., quantity of perceptual, spatial, and temporal information combined) in each of the elements separately.

3.3.3 Procedure

Upon arriving to the lab and providing informed consent, participants completed a demographic questionnaire measuring their age, sex, race, native language and education. Afterwards, they received a sealed envelope that contained a letter instructing them to complete no task, one task, or two tasks. The envelope was labelled only by participant number to ensure the researcher was blind to conditions during the interview. Task A consisted of helping to develop a promotional flyer for a café located at the University campus. Participants were instructed to walk across campus to the café

and to use the camera provided to take photos that could be included on a flyer to promote the café. In Task B, participants were requested to walk across campus to the bus stop located at the University Medical Centre. Upon arrival, they had to look for a woman named Michelle, of whom they were provided with a photo and informed she would be arriving by bus at some time that day. They were asked to wait for a minimum of five minutes, and to use the notepad and pen provided to write down the information of any buses that arrived or departed during their time. Participants were told to take a photo of Michelle using the camera provided, if they saw her arrive. In reality, Michelle was a fictitious character and participants did not encounter her during the task. Participants were given up to thirty-five minutes to complete their task/s. Both tasks were designed to ensure comparable duration and difficulty, as well as similarities regarding participants' familiarity with the routes and locations.

Participants were randomly assigned to complete no task, one task, or two tasks. For the participants who completed two tasks, the order was counter-balanced. Upon returning to the laboratory after completing their assigned task/s, participants received a second sealed envelope explaining they would be interviewed by the researcher about Tasks A and B and that they were to report and answer questions as if they had completed both tasks. As a result, four (between-subject) veracity conditions were created: Lie-Lie (participants who completed neither of the tasks), Lie-Truth and Truth-Lie (participants who completed either Task A or Task B), and Truth-Truth (participants who completed both tasks). The instruction letter contained a brief description of what Tasks A and B entailed to allow those who did not complete one or both of the tasks to familiarise themselves with what they would be reporting (see Appendix B). This also allowed liars to know, in advance of providing their statement, during which element/s of their statement they were required to lie. Participants were

told it was important to be convincing because (i) it would prevent them from having to stay an additional twenty minutes to provide a written account and (ii) it would earn them a chance to win a €50 raffle prize. After receiving these instructions, participants were given ten minutes alone to prepare.

Next, participants underwent a structured, information-gathering style interview (see Appendix B). The interviews were audio recorded. At the outset of the interview, the researcher stated that her goal was to obtain as much information as possible, and to determine the participant's credibility. The researcher also reminded participants that she was blind to the veracity condition, and instructed them to report as many details as possible, even if they did not think they were important. Each interview began with the elicitation of a free narrative of the participants' activities during the first task. The researcher then asked a series of questions such as "What else can you tell me about this task?", "How long did this task take you?", "Did anything unexpected happen?" The same procedure was repeated for the second task. Afterwards, the researcher gave participants an opportunity to provide any missing information regarding either task.

Following the interview, participants completed the Post-Interview Questionnaire. They were asked to rate several items on 5-point Likert scales (1 – strongly agree to 5 – strongly disagree): (i) I felt motivated to convince the interviewer that I completed both tasks, (ii) I had enough time to prepare for the interview, (iii) I prepared my statements strategically[4], (iv) I was successful in convincing the interviewer that I completed both tasks, (v) I think I will have to stay longer to provide a written statement. Participants then responded to two open-ended questions regarding their strategies for convincing the interviewer of their credibility and their strategic

[4] One participant's response to this question was not recorded via Qualtrics and therefore the results to this specific question are based on $N = 143$.

preparation. As well, participants responded to two multiple-response questions that asked them to select the verbal strategies (e.g., forthcomingness, avoidance, telling a plausible or clear statement, providing unverifiable details; see Table 3.5) and nonverbal strategies (e.g., maintaining eye contact, not fidgeting, appearing calm) they used when reporting each of the tasks separately. After completing the questionnaire, participants were debriefed and the experiment was concluded. None of the participants were asked to stay longer to provide a written statement and all participants were included in the raffle. The experiment lasted approximately one hour.

Coding[5]**.** ***Verbal content analysis*****.** The audio recorded interviews were transcribed verbatim. The Principal Investigator, who has expertise with verbal statement analysis, extensively trained two independent coders, both of whom were blind to the veracity of the statements. These coders assessed the statements for detail richness, represented by the sum of three types of detail; specifically, (1) perceptual details: Information about what the interviewee saw (e.g., "She wore a red blouse"), heard (e.g., "He talked loudly"), smelled (e.g., "It smelled like fresh cookies"), tasted (e.g., "It was bitter), or felt (e.g., "The sunshine was warm") during their activities; (2) spatial information: Information about locations (e.g., "On the elevator") or the spatial arrangement of people and/or objects (e.g., "The cups were on the bar"); and (3) temporal information: Information about when the activities or event happened (e.g., "It was 10:00am"), duration of an activity (e.g., "It took me six minutes to walk there"), or an explicit description of a sequence of events (e.g., "After getting my coffee, I left"). For each participant, the coders marked all perceptual, spatial, and temporal details individually in the text, and tallied the frequency of occurrence of each of these details

[5] The primary dependent variables in this study were selected based on previous research, which has found that the richer an account is perceived to be in spatial, temporal and perceptual information, the more likely it is to be truthful (e.g., Johnson, 2006).

for the element of the statement dealing with Task A and Task B individually. This coding scheme is publically available on the Open Science Framework.

The main coder and the second coder coded a randomly selected 20% of the statements in order to establish reliability. Inter-rater reliability between the two coders for each of the criteria in the total statements, using the two-way random effects model measuring consistency (e.g., Vrij, Leal, Jupe, & Harvey, 2018; Koo & Li, 2016), was high for perceptual information (Single Measures, Intraclass correlation coefficient, *ICC* = .91), spatial information (*ICC* = .89), and temporal information (*ICC* = .75). After confirming the reliability between the two coders, the second coder rated an additional 17 statements, and the main coder completed the remaining sample of participants' statements.

For the analyses, a total *richness of detail* score was calculated by summing the number of perceptual, spatial, and temporal details for the elements of the statement relating to Task A and Task B separately.

Finally, the clarity of statements was also coded (i.e., relating to RM; Johnson & Raye, 1981; Vrij, 2008a)[6]. This criterion was scored as present (1) if the statement was clear, sharp and vivid and scored as absent (0) if the statement was vague and dim. As well, I coded for the plausibility of statements and for the presence of unexpected complications. The latter two variables are not reported in the manuscript because floor effects were observed for each variable and therefore reliable data cannot be reported.

Strategies. To code the participants' self-reported strategies, one main coder examined the open-ended responses to establish data-driven categories (see Masip & Herrero, 2013). This entailed a multi-stage process that began by identifying each

[6] Inter-rater reliability between the two coders for the clarity of the total statements, using the two-way random effects model measuring consistency, was excellent (Single Measures, *ICC* = .91).

participant's strategy or strategies, then grouping together overlapping responses, and gradually condensing these responses into key categories based on conceptual similarities. The Principal Investigator oversaw each stage of this process and decided upon the final categories. A total of eight categories emerged from this coding method (see Table 3.4).

The main coder and a second coder then coded a randomly selected 20% of the participants' open-ended responses in order to establish inter-rater reliability regarding the classification of responses into the appropriate categories. Both coders were extensively trained in qualitative content analysis by the Principal Investigator. After confirming that the raters were consistent (Single Measures *ICCs* ranging from .55 to 1.00)[7], the main coder completed the remaining sample of participant responses and only these scores were used in the analysis.

In addition to coding participants' interview strategies, their self-reported methods of interview preparation were also examined. The same qualitative coding method as above was used for preparation coding. Inter-rater reliability was excellent (Single Measures *ICCs* ranging from .95 to 1.00). The main coder's scores for the entire sample were used in the analyses.

3.3.4 Analysis

To test whether the participants calibrated the richness of details of the elements according to the veracity of the preceding or following element, I conducted two 2 X 2 ANOVAs. First, I tested the effect of the first element on the second by submitting the richness of details in the second element to a 2 (veracity of the second element: [truth, lie]) X 2 (veracity of the first element: [truth, lie]) between-subjects ANOVA. Second,

[7] The average *ICC* across the eight strategies categories was .80. Two categories, relating to general linguistic control and behavioural control had low to moderate inter-rater reliability.

I tested the effect of the second element on the first element by submitting the richness of details in the first element to a 2 (veracity of the first element: [truth, lie]) X 2 (veracity of the second element: [truth, lie]) between-subjects ANOVA. Additionally, the data were examined by calculating a Bayesian ANOVA with default prior scales (i.e., r scale fixed effects at 0.5), using JASP. The Bayesian factors (*BF*; e.g., Lee & Wagenmakers, 2013) are reported in line with the guidelines by Jarosz and Wiley (2014), adjusted from Jeffreys (1961). The approximate evidence categories are as follows: Positive values between 1 and 3 indicate weak evidence for the alternate or null hypothesis, values between 3 and 10 indicate substantial evidence, values between 10 and 20 constitutes strong or very strong evidence, and values above 20 are considered very strong or decisive evidence. Evidence for the interaction term was calculated by dividing the interaction model by the main factors (e.g., Wagenmakers et al., 2016). For ease of interpretation, BF_{10} is used to indicate the Bayes factor as evidence in favor of the alternative hypothesis, whereas BF_{01} is used to indicate the Bayes factor as evidence in favor of the null hypothesis.

3.4 Results

Motivation, Preparation, & Self-Perceived Success

To test participants' motivation, preparation, and self-perceived success I conducted a series of 2 (veracity of the first element: [truth, lie]) X 2 (veracity of the second element: [truth, lie] between-subjects ANOVAs. Participants reported to have been highly motivated (M = 1.16, SD = 0.48), with no significant differences for the veracity of the first or the second element, $F(1, 140) = 0.03$, $p = .864$ and $F(1, 140) = 0.27$, $p = .607$, respectively. Participants overall endorsed that they had enough time to prepare for the interview (M = 1.03, SD = 0.28), with no significant differences for the veracity of the first or second element, $F(1, 140) = 0.09$, $p = .763$ and $F(1, 140) = 0.09$,

p = .763, respectively. Additionally, participants reported to have prepared their statements strategically (M = 2.45, SD = 1.08). A significant main effect emerged for the veracity of the first element, $F(1, 140) = 5.20$, p = .024, with participants who told deceptive first elements reporting more strategic preparation (M = 2.26, SD = 0.96) than participants who told truthful second elements (M = 2.65, SD = 1.16). The veracity of the second element also significantly affected the strategic preparation, $F(1, 140) = 11.69$, $p < .001$, with participants who told deceptive second elements reporting more strategic preparation (M = 2.17, SD = 0.96) than participants who told truthful second elements (M = 2.75, SD = 1.12). Regarding self-perceived success, participants were somewhat convinced they would be required to stay longer to provide a written statement (M = 3.33, SD = 0.97). There was a significant effect for the veracity of the first element, $F(1, 140) = 6.98$, p = .009, meaning that participants who reported deceptive first elements were more likely to believe they would have to stay longer (M = 3.13, SD = 0.95) relative to participants who reported truthful second elements (M = 3.54, SD = 0.11). I did not observe a significant effect of the veracity of the second element, $F(1, 140) = 1.99$, p = .161. There were no significant interaction effects (all p*'s* > .105).

Interview Preparation Techniques

Table 3.1 provides an overview of the data derived from the qualitative coding of participants' open-ended interview preparation techniques. Across veracity conditions, 40.38% of the mentioned preparation techniques related to "*Using imagination to prepare the statement"* (e.g., "imagine yourself doing the tasks and/or walking the routes"; "visualise the locations of the tasks"; and "imagine the sequence of events"). Roughly one quarter of the mentioned techniques related to "*Strategically preparing the statement and/or responses for the interview*" (23.46%; e.g., "anticipate

the interview structure and/or questions and prepare responses accordingly"; "practice the interview by yourself"; "construct the chronological order of events"), and approximately another quarter of techniques fell into the category of "*Purposefully manipulating the content (quantity/type of details) of the statement*" (22.31%; e.g., "fabricate specific details to be convincing"; "relate to memory and/or previous experiences"; "create a plausible and/or convincing story"). An additional 13.85% of mentioned techniques fell into an "*Other or miscellaneous*" category (e.g., "control the quantity of preparation time"; "use information provided in the instructions"; "be spontaneous"). As shown in Table 3.1, participants in the Lie-Lie condition reported the most techniques whereas those in the Truth-Truth condition reported the least. In general, the frequencies of reported preparation techniques were relatively consistent across the different veracity conditions.

Table 3.1

Frequency and percentage of interview preparation techniques across veracity conditions

Preparation Techniques	Condition			
	Truth-Truth	Lie-Lie	Truth-Lie	Lie-Truth
Use imagination to prepare the statement	17 **(29.82)**	38 **(50.67)**	27 **(40.91)**	23 **(37.10)**
Strategically prepare the statement and/or responses for the interview	16 (28.07)	13 (17.33)	15 (22.73)	17 (27.42)
Purposefully manipulate the content (quantity/type of details) of the statement	15 (26.32)	12 (17.33)	14 (21.21)	16 (25.81)
Other/Miscellaneous	9 (15.79)	11 (14.67)	10 (15.15)	6 (9.68)
Total frequency count per condition	57	75	66	62

Note. The frequencies and percentages are reported for $N = 142$ as two participant's scores were not recorded from the Qualtrics survey report for this question. The bolded numbers represent the category with the largest percentage per veracity condition.

Statement Clarity

I also examined whether veracity influenced the clarity of participants' accounts. A chi-square test of independence was first conducted between the clarity of element one and veracity condition. All expected cell frequencies were greater than five. There was a statistically significant association between the clarity of element one and veracity condition, $\chi^2(3) = 8.89$, $p = .031$. The association was moderately strong, $\varphi_c = 0.25$, $p = .031$. Crosstabulation results are presented in Table 3.2. The proportion of individuals whose first element of the statement was scored as clear was significantly higher for those in the Truth-Truth condition than for those in the Lie-Lie condition. Specifically, for individuals whose statement elements were both deceptive, 55.56% had their first element scored as unclear, whereas for individuals whose statement elements were both truthful, only 22.22% had their first element scored as unclear. Individuals whose statements contained a mixture of truthful and deceptive information were not significantly different in the evaluation of the clarity of their first element, regardless of the veracity. Thus, it appears that veracity significantly influenced the perceived clarity of interviewees' first elements of statements only when they were reporting entirely truthfully or entirely deceptively.

Table 3.2

Crosstabulation of clarity score and condition for element one

Clarity Score	Condition			
	Truth-Truth	Lie-Lie	Truth-Lie	Lie-Truth
Unclear (0)	8	20	14	12

	(-2.20)	**(2.60)**	(0.20)	(-0.60)
Clear (1)	28 **(2.20)**	16 **(-2.60)**	22 (-0.20)	24 (0.60)

Note. Adjusted residuals appear in parentheses below observed frequencies. Adjusted residuals in bold are those that exceed +/- 2.

Next, I conducted a second chi-square test of independence between the clarity of element two and condition, to examine the influence of veracity on the second element of participants' statements. All expected cell frequencies were greater than five. There was a statistically significant association between the clarity of element two and veracity condition, $\chi^2(3) = 10.36$, $p = .016$. The association was moderately strong, $\varphi_c = 0.27$, $p = .016$. The crosstabulation is presented in Table 3.3. The proportion of individuals whose second element was scored as clear was significantly higher for those in the Truth-Truth condition than for those in the Lie-Lie condition. Specifically, for individuals whose statement elements were both deceptive, 36.54% had their second elements scored as unclear, whereas for individuals whose elements were both truthful, only 15.38% had their second element scored as unclear. Individuals whose statements contained a mixture of truthful and deceptive information were not significantly different in the evaluation of the clarity of their second element. Similarly, veracity significantly influenced the perceived clarity of interviewees' second elements only when they were reporting entirely truthfully or entirely deceptively. Thus, statements were not more or less clear when they were preceded by a lie versus preceded by a truth, unless the statement was entirely truthful or deceptive.

Table 3.3

Crosstabulation of clarity score and condition for element two

	Condition

Clarity Score	Truth-Truth	Lie-Lie	Truth-Lie	Lie-Truth
Unclear (0)	8 **(-2.20)**	19 **(2.40)**	16 (1.20)	9 (-1.60)
Clear (1)	28 **(2.20)**	17 **(-2.40)**	20 (-1.20)	27 (1.60)

Note. Adjusted residuals appear in parentheses below observed frequencies. Adjusted residuals in bold are those that exceed +/- 2.

3.4.1 Richness of Detail

3.4.1.1 Confirmatory analyses. To test whether elements preceded by a lie would be less detailed than elements preceded by a truth (Hypothesis 2) a 2 (veracity of the second element: [truth, lie]) X 2 (veracity of the first element: [truth, lie]) between-subjects ANOVA was conducted on the richness of details in the second element. This analysis revealed a main effect of veracity of the second element, $F(1, 140) = 10.98$, $p = .001$, $\eta_P^2 = .073$; $BF_{10} = 22.00$, with truthful elements ($M = 34.76$, $SD = 18.26$, 95% CI [31.00, 38.53]) scoring higher on richness of details than deceptive elements ($M = 25.85$, $SD = 14.11$, 95% CI [22.09, 29.61]). The main effect of the veracity of the first element was not significant, $F(1, 140) = 3.01$, $p = .085$, $\eta_P^2 = .021$; $BF_{01} = 1.57$, meaning that the elements preceded by a lie ($M = 27.97$, $SD = 17.07$, 95% CI [24.21, 31.73]) were not significantly less rich in detail than elements preceded by a truth ($M = 32.64$, $SD = 16.45$, 95% CI [28.88, 36.40]). Finally, the interaction effect was also not significant, $F(1, 140) = 2.00$, $p = .160$, $\eta_P^2 = .014$; $BF_{01} = 1.74$, indicating the veracity of the first element had no differential effect on the richness of detail score of the second element. Taken together, these data support Hypothesis 1, that truthful elements are richer in detail than deceptive elements; however, there was no support

for the second hypothesis, that interviewees would calibrate the content of the second element to that of the first. See Figure 3.1.

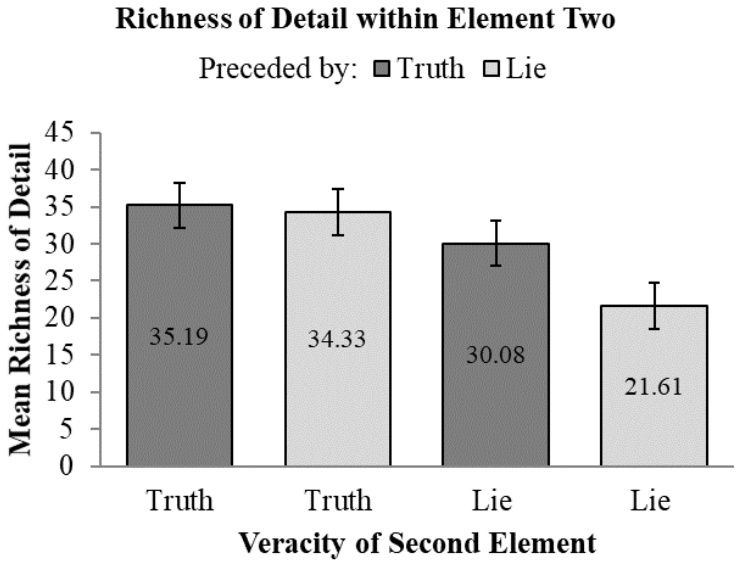


Figure 3.1. Mean richness of details in element two as a function of veracity condition. Standard errors are represented by the error bars attached to each symbol.

To investigate whether participants calibrated the first element according to the second element (Hypothesis 3) a 2 X 2 (veracity of the first element: [truth, lie] X veracity of the second element: [truth, lie]) between-subjects ANOVA was conducted on the richness of details in the first element. The main effect of veracity of the first element was significant, $F(1, 140) = 9.45$, $p = .003$, $\eta_P^2 = .063$; $BF_{10} = 10.79$, with truthful elements ($M = 35.71$, $SD = 14.42$, 95% CI [32.75, 38.67]) being richer in detail than deceptive elements ($M = 29.19$, $SD = 11.27$, 95% CI [26.23, 32.16]). The main effect of veracity of the second element was also significant, $F(1, 140) = 5.60$, $p = .019$, $\eta_P^2 = .038$; $BF_{10} = 1.95$, with the elements followed by a lie ($M = 29.94$, $SD = 13.48$, 95% CI [26.98, 32.91]) scoring lower on richness of details than the elements followed by a truth ($M = 34.96$, $SD = 12.73$, 95% CI [32.00, 37.92]). Lastly, the interaction effect was not statistically significant, $F(1, 140) = 1.50$, $p = .222$, $\eta_P^2 = .011$; $BF_{01} = 2.12$, indicating the veracity of the second element had no differential effect on the richness

of detail score of the first element. Overall, there was additional support for Hypothesis 1, that truthful elements are richer in detail than deceptive elements, and these data supported the third hypothesis, that interviewees would calibrate the content of the first element to that of the second. See Figure 3.2.

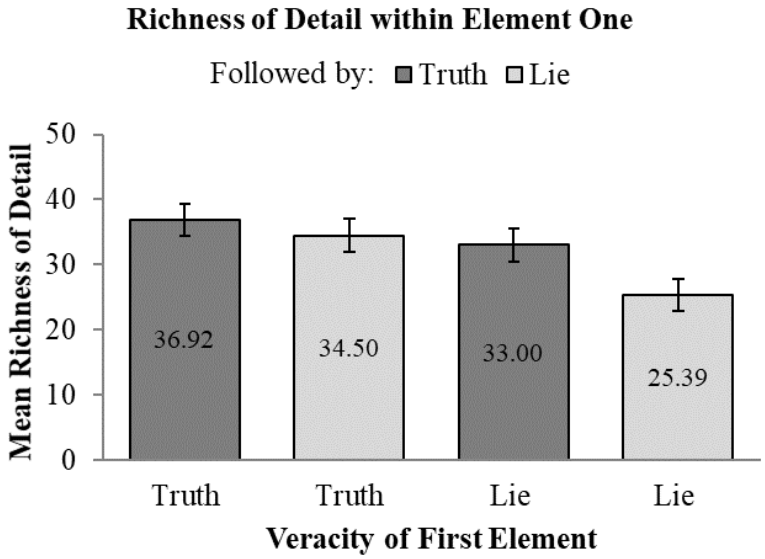


Figure 3.2. Mean richness of details in element one as a function of veracity condition. Standard errors are represented by the error bars attached to each symbol.

3.4.1.2 Exploratory analyses. As I was specifically interested in how lies are influenced by truthful information, I also carried out two exploratory independent-samples *t*-tests comparing the richness of details of lies only. I corrected for inflated type 1 error probability by applying a Bonferroni correction dividing the alpha of .05 by two, resulting in a significance level of .025. I found a statistically significant difference in mean richness of detail score of the deceptive second element between those preceded by a truth versus by a lie, $t(70) = -2.66$, $p = .010$; $BF_{10} = 4.64$, with those preceded by a lie ($M = 21.61$, $SD = 10.45$, 95% CI [14.80, 28.42]) being significantly less rich in detail than those preceded by a truth ($M = 30.08$, $SD = 16.05$, 95% CI [23.27, 36.89]). There was also a statistically significant difference in mean richness of detail score between deceptive first elements followed by a truth versus by a lie, $t(66.34) = -$

3.03, p = .004; BF_{10} = 10.81, indicating that a lie followed by another lie (M = 25.39, SD = 9.34, 95% CI [21.20, 29.58]) was significantly less detailed than a lie followed by a truth (M = 33.00, SD = 11.86, 95% CI [28.81, 37.19]).

3.4.2 Interviewees' Strategies

The vast majority of interviewees reported using strategies to enhance the likelihood that they would be perceived as credible: 95.49% of participants reported using one or more verbal strategies (e.g., telling a plausible story, keeping the statement clear and simple, reporting from previous memory; see Table 3.5) and 92.02% indicated using at least one nonverbal strategy (e.g., maintaining eye contact, not fidgeting, appearing confident, etcetera) during their interview. In this section, I will concentrate my reports primarily on the verbal strategies relating to my consistency hypotheses.

Overall interview strategies. Table 3.4 provides an overview of the data derived from the coding of participants' open-ended responses regarding their overall interview strategies. Across all veracity conditions, the most frequently mentioned verbal interview strategy was to "*Provide a detailed and plausible account*" (36.68% of all reported strategies). Only 7.34% of the reports fell into the category of "*Manipulating the verbal content by maintaining consistency between the statement elements*" (e.g., matching the type and quantity of details provided in both elements, adapting the deceptive story to the truthful story or vice versa, etcetera). As shown in Table 3.4, only participants in the Truth-Lie and Lie-Truth conditions reported strategies relating to maintaining consistency between their statements, with no significant difference in mean scores for endorsing the consistency strategy between these two conditions, $t(70) = 0.70$, p = .486; BF_{01} = 3.33. Thus, participants in the mixed veracity conditions reported similarly (albeit infrequent) strategic attempts to match the

consistency of their reports, whereas participants who fully lied or fully told the truth, did not report to use such a strategy.

Table 3.4

Frequency and percentage of overall interview strategies across veracity conditions

Interview Strategy	Condition			
	Truth-Truth	Lie-Lie	Truth-Lie	Lie-Truth
Provide a detailed, plausible account	21 **(40.38)**	22 **(30.99)**	27 **(38.03)**	25 **(38.46)**
Strategic control of behaviour	5 (9.62)	18 **(25.35)**	12 **(16.90)**	9 **(13.85)**
Manipulate verbal content: General linguistic control	1 (1.92)	9 (12.68)	8 (11.27)	7 (10.77)
Manipulate verbal content: Include truthful details	5 (9.62)	11 (15.49)	2 (2.82)	5 (7.69)
Use imagination to deliver the statement	2 (3.85)	5 (7.04)	5 (7.04)	9 (13.85)
Manipulate verbal content: Maintain consistency between elements	0 (0)	0 (0)	11 (15.49)	8 (12.31)
No strategy	7 (13.46)	6 (8.45)	4 (5.63)	1 (1.54)
Provide a truthful account	11 **(21.15)**	0 (0)	2 (2.82)	1 (1.54)
Total frequency count per condition	52	71	71	65

Note. The numbers reported represent the frequency occurrence of each strategy. The respective percentage within each condition is presented in brackets. Frequencies may add up to over 36 (the number of participants in each condition) because each participant could report multiple strategies that may have fallen into one or more categories. The bolded numbers represent the categories with the two largest percentages per veracity condition.

Interview strategies for individual statement elements. I was also interested in interviewees' strategies, relative to each element of the statement individually. Participants were asked to indicate which strategies they used for their reports of each Task A and Task B separately from a predetermined response set of multiple verbal strategies (see Table 3.5). Regarding the strategies for the second element of their statements, one of the most frequently endorsed strategies by participants in the Truth-Lie condition was *"Matching the amount of details in statements"* (13.82% of the endorsed strategies among this condition). Similarly, the same matching strategy was the most frequently endorsed strategy by participants in the Lie-Truth condition (17.89% of the endorsed strategies among this condition). This provides partial support for the prediction that interviewees in the mixed veracity conditions would report having strategically calibrated their verbal content based on the veracity of the preceding element. Taken together, these findings contribute partial support to Hypothesis 4, which predicted that the interaction between lies and truths would be, at least in part, reflected in participants' self-reported strategies.

Table 3.5

Frequency of verbal strategy endorsement for element one and two across conditions

Interview Strategy	Condition				Total
	Truth-Truth	Lie-Lie	Truth-Lie	Lie-Truth	
Strategies for Element One					
Forthcomingness	30	8	29	11	78
Telling a plausible story	13	24	12	23	72
Providing details the investigator cannot check	10	21	15	25	71
Keeping the statement clear and simple	17	21	11	15	64
Reporting from previous experience/ memory	6	22	7	19	54
Outright fabrication	1	11	2	18	32
Avoidance	3	12	5	10	30
Other	2	0	0	1	3
None	1	0	0	0	1
Total frequency counts	83	119	81	122	405

Strategies for Element Two					
Telling a plausible story	8	26	29	12	75
Providing details the investigator cannot check	10	21	21	15	67
Keeping the statement clear and simple	13	22	13	18	66
Forthcomingness	28	7	9	21	65
Matching the amount of details in statements	9	13	21	22	65
Matching the type of details in statements	8	12	19	16	55
Reporting from previous experience/ memory	8	12	19	8	47
Outright fabrications	5	9	13	1	28
Avoidance	2	14	8	7	31
Other	1	1	0	1	3
None	2	1	0	2	5
Total frequency counts	94	138	152	123	507

Note. The numbers reported represent the frequency of participants who endorsed each strategy.

3.5 Discussion

In line with previous research (e.g., Amado et al., 2016; DePaulo et al., 2003; Vrij, 2008a), I found support for my hypothesis that truthful elements are richer in detail than deceptive elements (Hypothesis 1). I also found evidence that truthful and deceptive information interacts to influence detail richness: (i) Elements followed by a lie were less detailed than elements followed by a truth (Hypothesis 3), and (ii) deceptive elements became more detailed when flanked by a truth than when flanked by a lie.

Participants only calibrated the detail richness of the first element based on the veracity of the second element. An explanation for this could be that participants knew, prior to the interview, whether they would be deceptive or honest about each element of the statement. When participants anticipated having to tell a lie in the second element of their statement, they may have already focused their efforts on this from the beginning of their interview (Jundi, Vrij, Hope, Mann, & Hillman, 2013). The directed attention of their cognitive resources towards ensuring the latter element of the statement was perceived as credible may have impaired the detail richness of the former

element of the statement. This directed attention could even provide an alternative explanation for the differences in detail richness between lies and truths. Given that these lies are most likely to actually consist of a mixture of truths and lies, it may not be memory processes, but directed attention that can account for the typical finding that lies are less detailed than truths.

I did not find support for the prediction that elements preceded by a lie would be less detailed than elements preceded by a truth (Hypothesis 2). Yet, the exploratory tests of lies only did reveal that participants calibrated their lies according to both the preceding and the following element, with deceptive elements becoming more detailed when flanked by a truth than when flanked by a lie. The discrepancy between these two findings may mean I had insufficient power to detect the main effect and/or interaction in the omnibus test. This is supported by the Bayes factors of 1.57 and 1.74, supplying only weak evidence for the absence of such effects. However, the results of the exploratory tests suggest that liars were intentionally calibrating the detail richness of their lies to that of the truths, perhaps to avoid noticeable inconsistencies between the truthful and deceptive elements of the statement. Future studies could examine whether this effect replicates, and if so, how lies become richer in detail.

From a motivational perspective, participants in the mixed veracity conditions had the same task: Providing a statement with one truthful element and one deceptive element. As a strategy, they could either i) boost the richness of details within the deceptive element making it resemble the truthful part, or ii) reduce the detail richness within the truthful element to make it resemble the deceptive element. My exploratory findings – that participants in the Truth-Lie and Lie-Truth conditions provided more details than participants in the Lie-Lie condition – suggest that interviewees applied the first strategy, increasing the detail richness of the deceptive element to match that of

the truthful element. More broadly, the order of presenting the truths and lies within statements, and not solely the veracity, could have influenced the richness of details provided by participants in the mixed veracity conditions. Specifically, interviewees may have preferred to begin by telling the truth and to integrate their lie midway through the statement, a pattern previously observed in a study examining deception within an insurance claim setting (Leal, Vrij, Nahari, & Mann, 2016). The tendency for insurance claimants to begin by reporting truthfully and to tell their lies as the interview progressed may have been an attempt to gain the investigator's trust or to become more comfortable with the interview setting and investigator. There may also have been a cognitive reason: Beginning with a lie increases cognitive demand meaning that interviewees have to formulate and intentionally activate a plausible lie while suppressing the truth (e.g., Vrij, 2015), during an unfamiliar situation. Real-world liars may not be obliged to report their lie during a specific component of the interview, and instead could opt to strategically incorporate their lie at the beginning, middle, or end of their free narrative account. Future research exploring when liars choose to incorporate their deception could provide insight into the production of embedded lies, which could, more broadly, inform interviewers on how to focus their investigative efforts at strategically important times during interviews.

I found only limited support for the prediction that the differences in the richness of details in statements would be reflected in participants' strategies (Hypothesis 4). Participants in the mixed veracity conditions reported similar, albeit infrequent, attempts to match the consistency of their statements, and participants who fully lied or fully told the truth, did not utilise such a strategy. The relatively low number of participants reporting to have used a consistency strategy corresponds to the modest effect sizes found in the quantitative analyses. As argued by Ericsson and Simon (1980),

when asking participants to make retrospective judgements regarding their behaviour, inconsistencies can arise because of the experimental procedures, particularly when using questions that are too general to prompt the information actually sought. Since broad strategy questions were asked, this could have led to less accurate responses.

This research was not without limitations. First, I examined the effect of two elements immediately following each other. This is appropriate to establish whether an effect appears, but future research could utilise a less artificial paradigm that better translates to applied contexts; for example, examining statements with lies and truths dispersed throughout. Similarly, my results may not generalise to situations in which the liar is unable to anticipate the exact topic or direction of the interview, such as when unexpected questions are asked. Perhaps in such situations, participants' strategic attempts to maintain consistency would not calibrate predominantly in the direction of the following element. Third, I cannot conclude that participants, who were instructed to lie, provided lies that were entirely untruthful. In fact, in the current study, participants across veracity conditions reported to have strategically included truthful details they had drawn from previous experiences and/or memory. Hence, I am left with deceptive statements that may be, realistically, a combination of truths and lies, which may have weakened the strength of the observed effects. Indeed, participants in the mixed veracity conditions may have easily borrowed truthful details from their experience of the completed task for their descriptions of the fabricated task, whereas complete liars may not have experienced any event rich in detail during the allotted time. This strengthens the argument that liars in the mixed veracity conditions draw on recent truthful previous memories to calibrate their statements whereas liars who provide entirely deceptive accounts may not. Fourth, the focus of this study was on one particular aspect of statement consistency: Consistency in detail richness. It is also

possible that the elements of participants' statements were consistent, or inconsistent, on other dimensions than detail richness, such as linguistic characteristics.

Another consideration is that the emotional pressure experienced by liars during actual investigative interviews is conceivably much higher than during psychological experiments. Additionally, nearly 80 percent of this sample was female, a disproportion that may also impact the generalisability of these findings since the majority of perpetrators that come to the attention of the criminal justice system are male (e.g., Heimer & Lauritsen, 2008; U.S. Department of Justice, 2009). However, it is unlikely that stakes or gender robustly influenced the results since the same theoretical assumptions and strategies should apply across low and high stakes contexts and for males and females.

I observed floor effects for the variables regarding unexpected complications and plausibility. One potential explanation is that the presence of complications may be situation-related. The low rate of reported complications in this sample could be because the reports were about short encounters scripted by the researcher, as opposed to longer activities initiated by the participant (e.g., Vrij et al., 2018). Additionally, the statements may have been judged as implausible since they were about unique experimental tasks as opposed to more believable day-to-day activities.

The research presented in this manuscript has two practical implications. First, the results show that liars are able to calibrate the detail richness of their lies to that of their truths. This presents a possible threat to the diagnostic accuracy and utility of verbal credibility assessment tools if liars are able to provide lies that mirror the richness of detail in the truthful components of their statement (e.g., Gnisci et al., 2010; Leins et al., 2017; Nahari, Vrij, & Fisher, 2012).

A second practical implication relates to the baseline technique. Baselining refers to the practice in which interviewers evaluate the veracity of a critical component of a statement relative to a baseline, or neutral, component of the same statement (see Vrij, 2016 for an overview). Baselining is frequently used by police in practice (Ewens, Vrij, Jang, & Jo, 2014; Frank, Yarbrough, & Ekman, 2006; Inbau, Reid, Buckley, & Jayne, 2013). This approach encourages starting an interview with a neutral – and often truthful – part. My findings indicate that interviewees calibrate the detail richness of the initial component of their statement based on the veracity of the following component. Therefore, if suspects manipulate the richness of details provided in their initial baseline statement to be consistent with the detail richness provided in their subsequent reports, then potential truth-lie differences may disappear. A possible preventative measure is for lie detectors to control for the event and to ask about the same event multiple times in different formats (e.g., first obtaining an oral account and then a sketch), using the first statement as a baseline (Vrij, 2016).

3.5.1 Conclusion

In sum, the current study addressed if and how truthful and deceptive information interacts to influence the richness of details in statements, and how this is reflected in individuals' strategies. The results indicate that interviewees calibrate the richness of detail provided in the first element of their statement based on the veracity of the following element, however, this effect was not robustly reflected in interviewees' self-reported strategies. Moreover, it seems that participants calibrate their lies according to both the preceding and the following element, with lies becoming more detailed when flanked by truthful information.

Chapter 4: Embedding lies into truthful stories

This chapter draws from the following manuscript:

Verigin, B. L., Meijer, E. H., & Vrij, A. (2019). Embedding lies into truthful stories does not affect their quality. *Revisions submitted to Applied Cognitive Psychology*.

4.1 Abstract

When given the opportunity, liars will embed their lies into otherwise truthful statements. In what way this embedding affects the quality of lies, however, remains largely unknown. This study investigated whether lies that are embedded into truthful stories contain more and higher quality details than lies that are part of entirely fabricated statements. Participants (N = 111) were asked to provide a statement that was either entirely truthful, entirely fabricated, or had the fabricated element of interest embedded into an otherwise truthful story. Results indicated that lies embedded in a fabricated statement are not qualitatively different from lies embedded in an otherwise truthful statement. Supporting Bayes factors provided moderate to strong evidence for this conclusion. Accordingly, verbal credibility assessment tools based on the verbal content measured in this study may be robust against the embedding of lies.

4.2 Introduction

Determining the credibility of a statement is a fundamental component of investigative and judicial decision-making, and it is therefore not surprising that numerous studies have examined how deceptive and truthful statements can be distinguished. This body of research has revealed that the accuracy of credibility assessments improves when judges rely only on the verbal content of a statement (Bond & DePaulo, 2006). Additionally, research has shown that good lie detectors report a higher reliance on verbal cues when making credibility judgments, whereas poor lie detectors tend to rely primarily on non-verbal cues (Mann, Vrij, & Bull, 2004).

A consistent finding in the deception literature is that truthful statements contain more details than deceptive ones (e.g., Amado, Arce, Fariña, & Vilarino, 2016; DePaulo et al., 2003), with a recent meta-analysis estimating the effect size of quantity of detail at d = 0.55 (Amado et al., 2016). Additionally, meta-analytical findings support the usefulness of temporal, visual, and auditory details for differentiating truthful from false accounts (Masip, Sporer, Garrido, & Herrero, 2005). On the basis of these variables, the accuracy rate of classifying truth-tellers and liars extends well beyond chance level (Masip et al., 2005; Vrij, Fisher, & Blank, 2017). The use of details as a cue to deception traces back to memory research. Reality Monitoring (RM; Johnson & Raye, 1981) theorises that memories derived from real experiences differ in quality from memories based on imagination, due to differences in the cognitive processes involved in externally versus internally generated memories. RM suggests that memories of real events are acquired through perceptual processes and therefore are more likely to contain details relating to sensory, spatial, temporal, and affective information, and to be generally more clear, sharp and vivid, compared to imagined events. Similarly, Criteria-Based Content Analysis (CBCA; Steller & Köhnken, 1989) is based on the

hypothesis that memories of personally experienced events differ in both quality (e.g., the logical structure or plausibility) and content (e.g., unexpected complications) to memories of fabricated or imagined accounts (Undeutsch, 1967, 1989). Research supports these theoretical rationales within lie detection contexts: Liars lack the memory traces truth-tellers have, leaving them unable to provide as many rich details as honest individuals (Masip et al., 2005; Oberlader et al., 2016; Vrij, 2008).

More recently, researchers have designed deception detection techniques based on the strategies interviewees report to try to deceive successfully. An example of such a strategy-based technique is the Verifiability Approach (VA; Nahari, Vrij, & Fisher, 2014a, 2014b). The VA works on the assumption that liars, on the one hand, are inclined to provide detailed statements to be perceived as cooperative and credible, but, on the other hand, want to minimise the chances that investigators can falsify their statement (Masip & Herrero, 2013; Nahari et al., 2014a). A strategy that meets both aims is to provide information that cannot be verified. Another example of a deception detection measure that is sensitive to the verbal strategies of liars and truth-tellers relates to common knowledge details (i.e., strongly invoked stereotypical information about events; Vrij, Leal, Mann et al., 2017). Whilst truth-tellers have personal, unique experiences of an event (DePaulo, Kashy, Kirkendol, Wyer, & Epstein, 1996), liars typically lack such information and their reports tend to be characterised by more general, impersonal knowledge (Sporer, 2016). An additional strategy-based measure relates to self-handicapping strategies (i.e., implicit or explicit justifications as to why someone is unable to provide certain information; Vrij, Leal, Mann et al., 2017). Liars are inclined to keep their stories simple; however, they are also aware that admitting a lack of knowledge and/or memory may generate suspicion from investigators (Ruby &

Brigham, 1998). A strategic solution then is to provide a justification for the failure to provide certain information.

Although it has been widely acknowledged that liars prefer to embed lies into otherwise truthful statements (e.g., Leins, Fisher, & Ross, 2013; Nahari, 2018a; Nahari & Vrij, 2015; Vrij, 2008; Vrij, Granhag, & Porter, 2010), it has not been addressed yet how telling embedded lies influences the verbal quality of those lies. One of the only previous studies to examine how lies differ when they are invented or based on past experiences found that the diagnostic accuracy of RM decreased when liars reported from previous experiences, yet liars and truth-tellers were still distinguishable even when such past experiences were used (Gnisci, Caso & Vrij, 2010). It remains unknown, however, how embedded lies are influenced by surrounding truthful information. Reasons to believe that the embedding of lies affects their quality stem from research on beliefs about cues to deception and liars' strategies. Previous research suggests that laypeople and legal professionals alike believe that inconsistency is symptomatic of deception (Blair, Reimer, & Levine, 2018; Vredeveldt, van Koppen, & Granhag, 2014; Strömwall & Granhag, 2003). Accordingly, one of the main concerns of liars – and one of their most frequently reported strategies – is to maintain consistency (Deeb, Vrij, Hope, Mann, Granhag, & Lancaster, 2017; Hartwig, Granhag, Strömwall, & Doering, 2010). For instance, Deeb et al. (2017) instructed liars to provide a statement containing reports of a deceptive event and a truthful event during two interviews. When asked about their strategies for appearing credible, 45% of liars mentioned maintaining consistency for both events between statements. Specifically, Deeb and colleagues (2017) found that many liars reported to have maintained consistency by strategically lowering their "baseline consistency" by including fewer repetitions in specific portions of the interview.

It is also possible that for interviewees who embed their lies into an otherwise truthful statement, efforts to maintain a consistent account may extend to the type and richness of details provided, causing their lies to become more richly detailed when surrounded by truthful information. Indeed, when a fragment of deception is incorporated into a truthful account, the liar may be able to borrow high quality information, such as perceptual, contextual and verifiable details, by drawing on the memory traces of their truthful experience to concoct their lie. The result would be that the content of embedded lies more closely resembles externally generated (i.e., truthful) memories, as opposed to internally generated (i.e., invented) memories (e.g., Leins et al., 2013; Nahari et al., 2014b). Recent research compared how interviewees strategically regulate the information they provide when their accounts contain both truths and lies, finding that lies became more richly detailed when flanked by truthful information compared to when flanked by other lies (Chapter 3 of this thesis). If liars are able to effectively blend together the deceptive and truthful aspects of their story to provide an account consistent in the quality of information, then tools such as RM and CBCA may be rendered less effective.

The present study aimed to examine the extent to which the embedding of lies affects their quality. Based on the different cognitive processes and strategic concerns of liars versus truth-tellers, I hypothesised that – in line with previous research (e.g., Amado et al., 2015; Masip et al., 2005; Nahari et al., 2014a, 2014b; Vrij, 2008) – *completely truthful* and *completely fabricated* statements would differ in number of details and the other characteristics outlined in Table 4.1 (Hypothesis 1). Based on my consistency assumption, I also predicted that *lies embedded into an otherwise truthful statement* would differ on those characteristics from *lies embedded into an entirely fabricated statement*. I anticipated that lies surrounded by truthful information would

be characterised by more detail richness. In addition, I expected more verifiable details, higher ratings of statement clarity and plausibility, and a higher proportion of complications (relative to common knowledge details and self-handicapping strategies) in lies embedded in truthful information relative to lies surrounded by deceptive information (Hypothesis 2; see Table 4.1).

Table 4.1

Previous research findings regarding the content cues of liars' and truth-tellers' statements

Veracity Cue	Direction of Support	Evidence Base
Richness of Details	More prevalent in truthful statements	Amado et al., 2016; DePaulo et al., 2003; Masip et al., 2005; Nahari, 2016; Oberlader et al., 2016; Vrij, 2005, 2008.
Verifiability of Details	More prevalent in truthful statements	Nahari, 2018b; Harvey, Vrij, Nahari, & Ludwig, 2016; Nahari et al., 2014a, 2014b.
Complications	More prevalent in truthful statements	Vrij, Leal, et al., 2017; Vrij, Leal, Fisher, et al., 2018; Vrij, Leal, Jupe, & Harvey, 2018; Vrij, Leal, Mann, et al., 2018.
Self-handicapping Strategies	More prevalent in deceptive statements	Vrij, Leal, et al., 2017; Vrij, Leal, Fisher, et al., 2018; Vrij, Leal, Jupe, & Harvey, 2018; Vrij, Leal, Mann, et al., 2018.
Common Knowledge Details	More prevalent in deceptive statements	Sporer, 2016; Volbert & Steller, 2014; Vrij, Leal, et al., 2017.
Statement Clarity	More prevalent in truthful statements	Johnson and Raye, 1981; Sporer and Küpper, 1995.

Statement Plausibility	More prevalent in truthful statements	DePaulo et al., 2003; Leal et al., 2015; Zhou, Burgoon, Nunamaker, & Twitchnell, 2004.

4.3 Method

4.3.1 Participants

The sample consisted of 111 undergraduate students, graduate students and staff members who were all naïve to forensic psychology (92 females; 19 males; M_{age} = 21.91 years; SD_{age} = 4.25). Participants described their ethnicity as Caucasian (n = 63), Black (n = 6), Asian (n = 6), or 'Other' (n = 36). An a-prior power analysis indicated that this number of participants was required to achieve an 80% likelihood of detecting a true difference given a medium effect size. All subjects participated in exchange for course credit or a £5 voucher and the opportunity to win a £50 raffle prize. Eligible participants were native-English speakers, aged 18 years or older. The study was approved by the standing ethical committee, and was pre-registered and approved via the Open Science Framework (OSF): http://j.mp/2D60QWu.

4.3.2 Procedure

Upon arriving to the lab and providing informed consent, participants completed a Pre-Interview Questionnaire followed by a demographic form measuring their age, sex, ethnicity, education and native-language. Participants then received a letter instructing them to imagine that they had been called into a police interview as a suspect in a burglary investigation, and that they must provide an alibi for their whereabouts during the day of the crime. Three conditions were created by providing participants with additional instructions. First, truth-tellers were told that they were innocent, and their task was to convince the interviewer of their innocence by providing a completely truthful alibi. In addition, two lie conditions were created. Liars were told

to imagine they were guilty of the hypothetical crime in question, and that they must lie about their whereabouts during the time of the burglary, that took place between 1:00pm and 3:00pm. Embedded liars were instructed to embed the critical 1:00pm to 3:00pm period in an otherwise truthful account, whereas in the Complete lie condition, liars were asked to fabricate the entire account (see Appendix C for the instructions). All participants were told it was important to be convincing because it would earn them a chance to win a £50 voucher and it would prevent them from having to stay an additional twenty minutes to provide a written account. After receiving these instructions, participants were given up to ten minutes alone to prepare.

The assignment to either the Truthful, Embedded lie, or Complete lie condition was done in a pseudo-random manner. The first five of every fifteen participants were assigned to the Truth-Teller condition, whereas the remaining participants (e.g., participants 6 to 15, 21 to 30, etcetera) were assigned to either the Embedded lie or Complete lie conditions. This was done so I could match the content of the critical period in the two lie conditions to that in the truthful condition. Specifically, the alibi activity that participants were instructed to lie about was generated based on the truth-tellers' responses to the Pre-Interview Questionnaire that asked them to briefly describe, in approximately one sentence, their activities between 1:00pm to 3:00pm on the previous three days. The Principal Investigator selected the activity that had the most unique, contextual detail and this selected activity was used for all three conditions, while making sure the assigned alibi activity differed from any of the liars' reported events. This pseudo-randomised design allowed us to experimentally control the type of activity reported and length of time between the experience and reporting (i.e., one, two or three days) across participants, thereby minimising confounding.

Next, a second researcher (blind to participants' conditions) began the interview by stating that her goal was to obtain as much information as possible, and to determine how credible the participant's account was. The interviewer instructed the participant to report as many details as possible, even if s/he did not think they were important. Each interview followed a structured format (see Appendix C) and was video-recorded. The interview began with the elicitation of a free narrative of the participants' activities from morning to evening on the day in question. The researcher then asked several questions, such as "What else can you tell me about that day?", "Did anything unexpected happen or perhaps something that did not go as planned?" Interviewees were also asked to report their activities during the 1:00pm to 3:00pm period specifically, and were given the opportunity to provide any forgotten or missing information at the end of the interview.

Following the interview, participants were informed that the experimental portion of the study had ended, that their answers to the following questionnaire would not influence how their statement would be assessed, and that they should answer the next questions honestly. Participants then completed the Post-Interview Questionnaire, where they were asked to rate several items on 5-point Likert scales (1 – strongly agree to 5 – strongly disagree): (i) The instructions clearly explained what I needed to do, (ii) I had enough time to prepare for the interview, (iii) I was motivated to convince the interviewer that I was innocent, (iv) I was successful in convincing the interviewer that I was innocent, (v) I prepared my statements strategically, (vi) The interviewer was friendly. Next, participants evaluated the truthfulness of both the critical and general components of their alibi using a 10-point scale (1 – not at all truthful to 10 – completely truthful). Finally, participants were debriefed and the experiment was concluded. None

of the participants were asked to stay longer and all participants were included in the raffle. Participation in the study took approximately one hour.

Coding[8]. Statements were assessed for the presence of spatial information (e.g., "Sitting in the row behind my friend"), temporal information (e.g., "It was 6:00pm") and perceptual information (e.g., "I saw him sitting at the bar"; *richness of detail*), the *verifiability of detail* (e.g., a receipt of purchase), the clarity and plausibility of the statement (*statement quality*), and the presence of *complications* (e.g., missing the bus), *common knowledge details* (e.g., "We went to pick up food at the store") and *self-handicapping strategies* (e.g., "My friend did all of the planning, so I can't remember"). The exact description of the verbal content coding can be found in Appendix C. Two scores were created for each dependent measure; the first was the sum of all occurrences in the entire statement, the second constituted the sum within the time period from 1:00pm to 3:00pm. To establish reliability, the Principal Investigator and a trained Research Assistant evaluated a randomly selected 20% of the statements. Using the two-way random effects model measuring consistency (see Koo & Li, 2016), inter-rater reliability was high for spatial information (Single Measures, Intraclass correlation coefficient, *ICC* = .79), temporal information (*ICC* = .93), and perceptual information (*ICC* = .78). The combined richness of detail variable thus had excellent reliability (*ICC* = .97), as did the verifiable details variable (*ICC* = .91). The *ICC's* were high for statement clarity (.90) and adequate for statement plausibility (.51), leading to a high reliability score for the combined statement quality variable (*ICC* = .87). The reliability

[8] The primary dependent variables in this study were selected based on previous research, which has found that the richer an account is perceived to be in spatial, temporal and perceptual information, the more likely it is to be truthful (e.g., Johnson, 2006). Moreover, I expanded my coding scheme from typical memory-based cues to also include recently developed variables relating to the verifiability of information and the proportion of complications. The latter two variables are strategy-based and have seen success in discriminating truths from lies (e.g., Nahari, Vrij, & Fisher, 2014a; Vrij, Leal, Jupe, & Harvey, 2018).

for coding the presence of complications, common knowledge details and self-handicapping strategies was also adequate (*ICC's* = .60, .51, and .71, respectively). After confirming the reliability between the two coders, the Principal Investigator completed the remaining sample of participants' statements, and only these scores were used in the analyses.

4.3.3 Deviations from Preregistration

The analyses reported here deviate from the preregistration in several ways. All deviations were decided upon prior to analysing the data. First, I preregistered two separate analyses, one based on 'quantity of details' (e.g., particular information regarding places, times, persons, objects and events) and one based on 'the richness of detail'. Instead, I limit my analysis to 'richness of detail,' a combination of all spatial, temporal and perceptual information. Second, I preregistered predictions based on a measure combining the frequency of complications, self-handicapping strategies, and common-knowledge details. Instead, I coded the frequency of each cue separately and calculated the proportion of complications score (complications/ [complications + common knowledge details + self-handicapping strategies]). This is in line with previous literature (see, for example, Vrij, Leal, Jupe et al., 2018) and has theoretical advantages given that it is a within-subjects comparison that is also sensitive to the different verbal strategies used by liars and truth-tellers.

4.4 Results

Motivation, Preparation, and Self-Perceived Success

Participants reported to have been highly motivated (M = 4.65, SD = 0.72), that they had enough time to prepare for the interview (M = 4.90, SD = 0.45), and that they had prepared their statements somewhat strategically (M = 3.85, SD = 1.08). There were no significant differences in motivation and preparedness between veracity conditions,

$F(2, 108) = 0.15$, $p = .858$, $\eta_P^2 = .003$, $F(2, 108) = 1.27$, $p = .284$, $\eta_P^2 = .023$, and $F(2, 108) = 2.31$, $p = .104$, $\eta_P^2 = .041$, respectively. There were significant differences between the veracity conditions for reported success in convincing the interviewer that participants were innocent, $F(2, 108) = 4.74$, $p = .011$, $\eta_P^2 = .081$. Truth-tellers reported being the most successful ($M = 4.14$, $SD = 0.82$), followed by liars in the Embedded lie condition ($M = 3.78$, $SD = 0.82$), and lastly liars in the Complete lie condition ($M = 3.51$, $SD = 0.96$). Post hoc comparisons using the Bonferroni procedure indicated that the mean difference in self-perceived success was only statistically significant between the truth-tellers and liars in the Complete lie condition ($p = .008$).

4.4.1 Truthfulness Measures

Participants were asked to rate, on a scale of one to ten (one being not at all truthful and ten being completely truthful) how truthful the 1:00pm to 3:00pm component of their alibi statement was. Significant differences emerged between the conditions, $F(2, 108) = 136.21$, $p < .001$, $\eta_P^2 = .716$. Truth-tellers reported that the critical component of their alibi was almost completely truthful ($M = 9.59$, $SD = 0.90$), whereas liars in the Complete lie ($M = 2.46$, $SD = 2.57$) and Embedded lie ($M = 2.62$, $SD = 2.48$) conditions indicated that only a small portion of their critical alibi component was truthful. Post hoc comparisons showed that the mean difference in reported truthfulness was statistically significant only between the truth-tellers and liars in the Complete lie condition ($p < .001$) and between the truth-tellers and liars in the Embedded lie condition ($p < .001$). Thus, the self-reported truthfulness of the critical component of interviewees' alibi statements conformed to the instructions they received across conditions.

Similarly, participants were asked to rate, on the same ten-point scale, how truthful their general alibi statement was, excluding the period from 1:00pm to 3:00pm.

Significant differences emerged between the conditions, $F(2, 108) = 75.82$, $p < .001$, $\eta_P^2 = .584$. Truth-tellers reported that the majority of their general alibi was truthful ($M = 9.32$, $SD = 0.88$). Liars in the Complete lie condition reported that a portion of their general alibi was truthful ($M = 3.32$, $SD = 2.76$), whereas liars in the Embedded lie condition reported that the majority of their general alibi was truthful ($M = 7.92$, $SD = 2.45$). Post hoc comparisons indicated that the mean difference in reported truthfulness was significant between truth-tellers and liars in the Embedded lie condition ($p = .002$), between truth-tellers and liars in the Complete lie condition ($p < .001$) and between liars in the Embedded lie and liars in the Complete lie conditions ($p < .001$). As above, the self-reported truthfulness of the general component of interviewees' alibi statements mostly corresponded to the instructions they received across conditions.

My primary analyses focused on examining the characteristics between entirely truthful statements versus entirely fabricated statements, and between the deceptive 1:00pm to 3:00pm period embedded in lies and embedded in truths. Additionally, two exploratory analyses were conducted[9]. I compared the characteristics of the deceptive 1:00pm to 3:00pm period embedded in truths with the truthful 1:00pm to 3:00pm period also embedded into truths, and compared the truthful parts of the statement flanking the deceptive 1:00pm to 3:00pm period to the truthful parts of the statement flanking the truthful 1:00pm to 3:00pm period.

4.4.2 Statement Characteristics

4.4.2.1 Confirmatory hypothesis testing. Statement characteristics were analysed using a series of univariate between-subjects ANOVAs. Additionally, the data

[9]An alternative analysis would be to run within-participant analyses to compare truth-lie differences. Such analyses are methodologically inappropriate as these comparisons potentially confound truth-lie differences with duration and activity; specifically, the critical period spanned two hours, whereas a morning and evening can describe a more variable period, and will likely describe different activities.

were examined by calculating a Bayesian ANOVA with default prior scales (i.e., r scale fixed effects at 0.5), using JASP software. The Bayesian factors (*BF*; see Jarosz & Wiley, 2014; Lee & Wagenmakers, 2013) are reported in line with the guidelines by Jarosz and Wiley (2014), adjusted from Jeffreys (1961). The approximate evidence categories are as follows: Positive values between 1 and 3 indicate weak evidence for the alternate or null hypothesis, between 3 and 10 indicate substantial evidence, between 10 and 20 constitutes strong or very strong evidence, and scores above 20 are considered very strong or decisive evidence. For ease of interpretation, BF_{10} is used to indicate the Bayes factor as evidence in favour of the alternative hypothesis, whereas BF_{01} is used to indicate the Bayes factor as evidence in favour of the null hypothesis.

I first tested Hypothesis 1 by comparing the completely truthful to the completely fabricated statements on i) the richness of details (i.e., amount of spatial, temporal, and perceptual information combined), ii) the amount of verifiable details, iii) the quality of statements (i.e., the clarity/plausibility), iv) the number of complications, common knowledge details and self-handicapping strategies and v) the total proportion of complications (i.e., complications/[complications + common knowledge details + self-handicapping strategies]). Truthful statements (M = 56.46, SD = 27.85) scored higher on richness of details than fabricated statements (M = 41.38, SD = 15.66), $F(1, 72) = 8.24$, $p = .005$, $\eta_P^2 = .103$, $BF_{10} = 7.51$. Additionally, truthful statements (M = .30, SD = .62) contained significantly fewer self-handicapping strategies than fabricated statements (M = .65, SD = .86), $F(1, 72) = 4.09$, $p = .047$, $\eta_P^2 = .054$, $BF_{10} = 1.34$. I did not observe significant effects of Veracity on the remaining dependent variables: The amount of verifiable details, $F(1, 72) = 1.76$, $p = .189$, $\eta_P^2 = .024$, $BF_{01} = 1.96$; the quality of statements, $F(1, 72) = .70$, $p = .407$, $\eta_P^2 = .010$, $BF_{01} = 3.08$; the number of complications, $F(1, 72) = 1.54$ $p = .219$, $\eta_P^2 = .021$, $BF_{01} = 2.15$;

the number of common knowledge details, $F(1, 72) = 2.88$, $p = .094$, $\eta_P^2 = .038$, $BF_{01} = 1.22$; the proportion of complications, $F(1, 72) = 2.65$, $p = .108$, $\eta_P^2 = .036$, $BF_{01} = 1.34$.

Next, I tested Hypothesis 2 by conducting a second series of univariate between-subjects ANOVAs to compare the 1:00pm to 3:00pm period between the Embedded lie and Complete lie conditions. The exact values can be found in Table 4.2. Only one significant difference emerged: Liars in the Complete lie condition provided some self-handicapping strategies ($M = .11$, $SD = .32$) during the critical portion of the alibi, whereas those in the Embedded lie condition did not provide any, $F(1, 72) = 4.36$, $p = .040$, $\eta_P^2 = .057$, $BF_{10} = 1.53$. I did not observe a significant effect for the remaining variables: The richness of detail, $F(1, 72) = .21$, $p = .648$, $\eta_P^2 = .003$, $BF_{01} = 3.80$; the amount of verifiable details, $F(1, 72) = 1.26$, $p = .265$, $\eta_P^2 = .017$, $BF_{01} = 2.42$; the quality of statements, $F(1, 72) = .17$, $p = .685$, $\eta_P^2 = .002$, $BF_{01} = 3.88$; the number of complications, $F(1, 72) = 1.13$, $p = .292$, $\eta_P^2 = .015$, $BF_{01} = 2.57$; the number of common knowledge details, $F(1, 72) = 3.22$, $p = .077$, $\eta_P^2 = .043$, $BF_{01} = 1.05$; the proportion of complications, $F(1, 72) = 0.77$, $p = .382$, $\eta_P^2 = .011$, $BF_{01} = 2.98$. In sum, my analysis revealed no differences between lies embedded in truths and lies embedded in lies, with Bayes Factors demonstrating weak to substantial evidence in favour of the null hypothesis. The only exception was self-handicapping strategies.

4.4.2.2 Exploratory hypothesis testing. Having found that lies embedded in otherwise truthful statements did not differ from lies embedded in an otherwise deceptive statement, I was also interested to what extent these embedded lies could be distinguished from truths. I therefore conducted an exploratory analysis of the 1:00pm to 3:00pm period between the Embedded lie condition (lie embedded into a truthful statement) and the Truth-Teller condition (truth also embedded into a truthful

statement). The embedded truths (M = 21.22, SD = 12.33) were significantly richer in detail than the embedded lies (M = 15.22, SD = 9.65), $F(1, 72) = 5.43$, $p = .023$, $\eta_P^2 = .070$, $BF_{10} = 2.39$. Embedded truths (M = 2.95, SD = 1.10) were also rated as having higher statement quality than embedded lies (M = 2.35, SD = 1.25), $F(1, 72) = 4.69$, $p = .034$, $\eta_P^2 = .061$, $BF_{10} = 1.76$. I did not find significant differences for the remaining variables: The amount of verifiable details, $F(1, 72) = 3.74$, $p = .057$, $\eta_P^2 = .049$; $BF_{01} = 0.85$; the number of complications, $F(1, 72) = 0.25$, $p = .616$, $\eta_P^2 = .004$, $BF_{01} = 3.73$; the number of common knowledge details, $F(1, 72) = 3.12$, $p = .082$, $\eta_P^2 = .042$, $BF_{01} = 1.10$; the number of self-handicapping strategies, $F(1, 72) = 2.06$, $p = .156$, $\eta_P^2 = .028$, $BF_{01} = 1.72$; the total proportion of complications, $F(1, 72) = 1.00$, $p = .321$, $\eta_P^2 = .014$, $BF_{01} = 2.71$. Exact values can be found in Table 4.2. These results indicate that lies embedded into otherwise truthful accounts can be differentiated from truths based on detail richness and statement quality, although the Bayes factors indicate the evidence for this is weak at best.

Table 4.2

Exact values of dependent measure scores in the critical and general statement components as a function of veracity condition

Dependent Variable	Veracity Condition	Statement Component	Mean Value	Confidence Intervals (95% CI)
Richness of Detail*+	Truth-teller*+	1:00 – 3:00pm*	21.22	[17.10, 25.33]
		General statement+	56.46	[47.17, 65.75]
	Embedded liar*	1:00 – 3:00pm*	15.22	[12.00, 18.43]
		General statement	51.68	[43.68, 59.67]
	Complete liar+	1:00 – 3:00pm	14.24	[11.39, 17.09]
		General statement+	41.38	[36.16, 46.60]
Verifiability of Details	Truth-teller	1:00 – 3:00pm	3.14	[2.29, 3.98]

		General statement	9.57	[7.75, 11.38]
	Embedded liar	1:00 – 3:00pm	2.14	[1.51, 2.76]
		General statement	8.14	[6.68, 9.60]
	Complete liar	1:00 – 3:00pm	2.70	[1.89, 3.52]
		General statement	8.00	[6.43, 9.57]
Statement Quality*	Truth-teller*	1:00 – 3:00pm*	2.95	[2.58, 3.31]
		General statement	2.73	[2.37, 3.09]
	Embedded liar*	1:00 – 3:00pm*	2.35	[1.93, 2.77]
		General statement	2.35	[2.00, 2.70]
	Complete liar	1:00 – 3:00pm	2.46	[2.12, 2.80]
		General statement	2.54	[2.25, 2.83]
Complications	Truth-teller	1:00 – 3:00pm	0.22	[0.04, 0.39]
		General statement	0.89	[0.41, 1.37]
	Embedded liar	1:00 – 3:00pm	0.16	[0.04, 0.29]
		General statement	1.08	[0.26, 1.90]
	Complete liar	1:00 – 3:00pm	0.08	[-0.01, 0.17]
		General statement	0.54	[0.23, 0.85]
Common Knowledge details	Truth-teller	1:00 – 3:00pm	1.41	[0.95, 1.86]
		General statement	6.14	[4.91, 7.36]
	Embedded liar	1:00 – 3:00pm	2.00	[1.49, 2.51]
		General statement	7.76	[6.37, 9.14]
	Complete liar	1:00 – 3:00pm	1.43	[1.04, 1.82]
		General statement	7.57	[6.37, 8.77]
Self-handicapping strategies+	Truth-teller+	1:00 – 3:00pm	0.05	[-0.02, 0.13]
		General statement+	0.30	[0.09, 0.50]
	Embedded liar	1:00 – 3:00pm	0.00	[0.00, 0.00]
		General statement	0.43	[0.22, 0.65]
	Complete liar+	1:00 – 3:00pm	0.11	[0.00, 0.21]

		General statement+	0.65	[0.36, 0.93]
Proportion of complications	Truth-teller	1:00 – 3:00pm	0.13	[0.02, 0.23]
		General statement	0.15	[0.06, 0.24]
	Embedded liar	1:00 – 3:00pm	0.07	[0.00, 0.13]
		General statement	0.13	[0.04, 0.21]
	Complete liar	1:00 – 3:00pm	0.03	[-0.01, 0.07]
		General statement	0.07	[0.02, 0.11]

Note. The asterisks (*) indicate the dependent variables with statistically significant differences for the 1:00 to 3:00pm critical component and where these differences occurred. The plus signs (+) indicate the dependent variables with statistically significant differences for the general component and where these differences occurred.

I preregistered my hypothesis that lies embedded in truths would be richer in detail than lies incorporated into fully fabricated accounts. It is, however, also possible that embedded lies affected the flanking truthful component. To investigate this, I conducted a series of independent samples *t*-tests on the dependent measures between the truthful portions flanking the embedded lies, and the same components flanking the truths. Embedded liars (M = 36.46, SD = 17.91) and truth-tellers (M = 35.24, SD = 20.74) provided similar richness of detail in the truthful components of their statements, $t(72) = -.27$, $p = .788$, $d = -.06$, $BF_{01} = 4.03$. Similarly, I did not find significant differences for the remaining variables: The amount of verifiable details, $t(72) = .34$, $p = .735$, $d = .08$, $BF_{01} = 3.96$; the number of complications, $t(72) = -.47$, $p = .639$, $d = -.11$, $BF_{01} = 3.78$; the number of self-handicapping strategies, $t(72) = -1.15$, $p = .253$, $d = -.27$, $BF_{01} = 2.35$; the number of common knowledge details, $t(72) = -1.40$, $p = .165$, $d = -.33$, $BF_{01} = 1.79$. These results indicate that the truthful components of statements were consistently rich in detail, and included similar types of detail, regardless of whether the statement was entirely truthful or contained an embedded lie.

4.5 Discussion

This experiment investigated how the verbal content of lies was affected by embedding them into otherwise truthful statements. My primary hypothesis, that lies embedded in truthful information would be richer in details and other truth-associated criteria than lies that are part of completely fabricated statements, was not supported (Hypothesis 2). Consequently, lies embedded in otherwise truthful statements and lies embedded in deceptive statements could be distinguished from truths equally well. My finding that lies embedded in truthful statements can be differentiated from truths that are part of fully truthful accounts is comparable to that of Gnisci and colleagues (2010). It is encouraging that in both studies, even when liars incorporate truthful, previously experienced information into their fabrications, differences still exist between these deceptive and truthful elements. This has important implications for practice, as it means that tools used in in the field such as CBCA may be robust to the influence of embedded lies.

Compared to being entirely truthful or entirely deceptive, telling a mixture of truths and lies could have resulted in reporting more details about the deceptive parts of their statement, fewer details about the truthful parts of their statement, or a combination of both. The lack of difference between the two types of lies suggests that embedded liars were not able to maintain consistency between the truthful and fabricated components of their statements, given that their lies did not become more detailed to mirror the truths. A potential explanation could be that, without specific knowledge of the criteria indicative of truthfulness, it would be difficult for liars to produce a fabricated element that is comparable in detail and quality to the truthful component. The only observable difference between the two types of lies was with regard to the presence of self-handicapping strategies; however, the observed significance can be explained by a floor effect meaning this result should be interpreted

with caution. Additionally, I found that interviewees provided similar types and richness of detail in the truthful components of their accounts, regardless of whether this component was flanked by truthful or deceptive information. This provides interesting insight into the high quality of statements that could potentially be provided by embedded liars.

When comparing the entire statement, completely truthful accounts differed from fully fabricated accounts, though only with regard to the richness of detail and self-handicapping strategies (Hypothesis 1). Importantly, richness of detail is the most empirically supported cue from the literature and therefore contributes strong insights to my pattern of results. I failed to replicate previous findings that truthful accounts contain more verifiable details than deceptive ones. A potential explanation for the discrepancy between my findings and the general verifiability literature is that I did not employ the entire VA procedure (see also Bogaard, Meijer, & Van der Plas, 2019). Research suggests that the VA approach is most effective when, prior to their interview, interviewees are requested to include details that the investigator can check – what is known as the information protocol (Harvey et al., 2016; Nahari et al., 2014b). I opted not to use this protocol because this instruction may have affected liars' and truth-tellers' responses and influenced the dependent measures of this experiment.

I did not find the proportion of complications to be a diagnostic cue to veracity in any of the three comparisons. This may have been due to floor effects in the sample (truthful interviewees in this study reported on average, less than one complication, relative to other studies in which truthful reports typically produce an average of ten or more complications; e.g., Vrij, Leal, Jupe, et al., 2018; Vrij, Leal, Mann, et al., 2017). Regarding common knowledge details, it has been suggested that truthful interviewees sound scripted in their reports if they underestimate the amount and type of detailed

information they are required to report (Vrij, 2018). A potential reason for not observing significant differences with regard to the proportion of complications was due to the reduced time period, as well as the events, that participants were reporting in their alibi statement. If participants had reported longer, more dynamic statements, perhaps after exposure to a model statement, then the proportion of complications may have been a more effective cue.

I also did not observe differences regarding the statement quality between completely truthful statements and completely fabricated statements when comparing the entire accounts, yet I did replicate this effect when comparing only the embedded 1:00pm to 3:00pm component of the alibis. Reporting truthfully involves retrieving and reconstructing one's memory, whereas constructing a lie involves fabricating a story based on scripted knowledge about comparable situations and events (Schank & Abelson, 1977). Considering that liars in this study admitted having included some truthful information in their statements, it is possible that this allowed their overall statements to come across equally as clear and plausible as honest interviewees.

4.5.1 Limitations and Future Research

The goal of this study was to examine embedded lies and I did so by isolating a critical statement of interest while manipulating the veracity of the surrounding components. However, the period for which the liars came up with spanned two hours. In real-life, liars may stay as close to the truth as possible, only fabricating or omitting a few key, incriminating details. Future research could extend this paradigm to accommodate for the dispersion of truths and lies throughout a statement and particularly how interviewees' verbal content may be inconsistent when they lie and tell the truth in a single account. Moreover, future research should continue this research line to explore the verbal quality of *whole* statements that contain an embedded lie,

particularly in terms of how they may differ from entirely fabricated or truthful stories. Such comparisons would more likely mirror the real-world circumstances of investigators, who typically are not privy to the specific point within a statement at which an interviewee will incorporate their lie.

A second limitation is that the self-reported truthfulness ratings revealed that liars instructed to fabricate their entire account reported still including some truthful information, and the embedded liars reported that their general statement was mostly truthful, but still included some lies. This may be methodologically somewhat awkward but it does reflect what liars typically do: Providing statements that contain a mixture of truths and lies (Leins et al., 2013, Leins, Zimmerman, & Polander, 2017). As such, the finding is high in ecological validity. Using self-report, I checked that liars did not engage in the assigned activity on the day in question nor on any adjacent days. However, this does not exclude the possibility that they engaged in the activity on an earlier occasion and could have drawn from this truthful experience, simply displacing it in time. Future research that manipulates the type of lie that interviewees provide, such that it cannot be readily drawn from a potential previous experience, may produce a different pattern of results. Another methodological adjustment that may yield different findings would be allowing participants to choose the topic of their report, rather than constraining their reports to an activity scripted by the experimenter. This would more appropriately reflect the circumstances of real-world liars, who are typically not forced to report any particular event (e.g., Leins et al., 2013).

Another important consideration relates to ground truth. This study involved interviewees reporting self-generated stories within a naturalistic alibi scenario. I established partial ground truth via my truthfulness measures, which indicated that participants largely conformed to the experimental instructions. I was unable to further

corroborate participants' accounts, however. Although the current experiment ensured that participants were emotionally engaged with the experimental process and similar paradigms have been used extensively by deception researchers (e.g., Elntib, Wagstaff, & Wheatcroft, 2015; Masip et al., 2005; Sporer & Sharman, 2006), future research would benefit from attempting to establish ground truth. A possible way to do so without having to resort to artificial mock crime procedures would be to require participants to wear a video-recording device for a certain duration of hours over a period of several days. Then, the researcher could verify the veracity of the interviewees' reports in the subsequent interview (e.g., Meixner & Rosenfeld, 2014). A drawback of this design, however, is the requirement for extensive resources.

4.5.2 Conclusion

In sum, I showed that truthful statements could be distinguished from fabricated ones, and that lies embedded in otherwise truthful statements did not differ from lies embedded in deceptive statements. I also showed that lies embedded in otherwise truthful statements could be distinguished from truths embedded in truthful statements. Accordingly, verbal credibility assessment tools based on verbal content measured in this study may be robust against the embedding of lies.

Chapter 5: A within-statement baseline comparison for detecting lies

This chapter draws from the following manuscript:

Verigin, B. L., Meijer, E. H., & Vrij, A. (2019). A within-statement baseline comparison for detecting lies. *Manuscript submitted for publication.*

5.1 Abstract

The comparable baseline technique can increase observers' ability to distinguish truth-tellers from liars. This study further investigated whether a within-statement verbal baseline comparison could enhance discriminatory accuracy. Participants (n = 148) read an alibi statement of a mock suspect and provided a veracity judgement regarding a critical two-hour period within the alibi statement. This critical element was either deceptive or truthful and was embedded into an otherwise truthful story. Half of the participants received additional instructions to use the surrounding truthful elements of the statement as a baseline. Instructing participants to make a within-statement baseline comparison did not improve the accuracy of credibility assessments. The finding that a within-statement verbal baseline comparison may not be an effective lie detection tool has applied relevance given police officers' potential reliance on this type of technique during investigations. Future research should prioritise verbal baselining techniques that control for both the individual and the situation.

5.2 Introduction

Deception researchers typically report their results at group level. For example, research shows that, on average, liars' statements are typically less richly detailed than those of their truth-telling counterparts (e.g., Amado, Arce, Fariña, & Vilarino, 2016; DePaulo et al., 2003; Luke, 2019). Legal practitioners, in contrast, are rarely interested in group level statistics. They need to know if an interviewee in the case at hand is being deceptive or honest. However, group-derived estimates do not always reliably generalise to individual cases (Fisher, Medaglia, & Jeronimus, 2018; Faigman, Monahan, & Slobogin, 2014).

One option that facilitates decisions at the individual level is to include a within-individual comparison (see Vrij, 2016 for a discussion). One such method, reportedly used in practice by some North American police (Ewens, Vrij, Jang, & Jo, 2014; Frank, Yarbrough, & Ekman, 2006; Inbau, Reid, Buckley, & Jayne, 2013; U.S. Department of the Army, 2006) is the baseline technique. With this technique, interviewers evaluate an interviewee's "statement of interest" (i.e., part of the statement for which veracity is being assessed) relative to a baseline statement (i.e., part of the interview which is known to be truthful). Deception is then determined by looking for deviations from this established baseline. In fact, 71% of experienced U.S. human intelligence interviewers reported to rely on deviations from baseline to detect deception (Russano, Narchet, Kleinman, & Meissner, 2014).

A reason to believe in the efficacy of baselining as a lie detection technique derives from early research on the relationship between familiarity and deception. A handful of studies from the late 20th century examined how the level of familiarity between a liar and an observer affects lie detection outcomes (e.g., Brandt, Miller, & Hocking, 1980a, 1980b, 1982; Comadena, 1982; Ekman & Friesen, 1974; Feeley,

deTurck, & Young, 1995; Hayano, 1980; McComack & Parks, 1986). Collectively, this research showed that veracity judgements were most accurate when observers had the opportunity to become familiar with the respondents' truthful communication style. For example, Feeley et al. (1995) had participants judge the veracity of truthful and deceptive communicators after viewing between zero to four exposures of the sender. They found a positive linear relationship between the amount of familiarity with the sender and judges' accuracy. In their meta-analysis, Bond and DePaulo (2006) compared deception detection accuracy between judges who had, versus those who had not, been previously exposed to the individual they were evaluating. Their results showed that when judges had been previously exposed to a target, this baseline exposure or baseline familiarity significantly improved their detection accuracy from 52% to 56%. These results offer important insights for the benefit of baseline familiarity when the sender is familiar to the receiver, such as in personal relationships.

In police interviews, interviewer and target are more likely to be strangers, and another option is to use part of the same interview as a statement. Ewens and colleagues (2014) examined the behavioural patterns of interviewees in response to non-threatening "small-talk" baseline questions prior to an interview compared to their responses during target periods of an investigative interview. The results indicated no effect of the baseline: Both truthful and deceptive interviewees behaved equally different between the small-talk baseline and investigative part of the interview. Palena, Vrij, Caso, and Orthey (2018) examined two types of baselines: An initial small-talk baseline and a comparable truth baseline (i.e., a set of questions designed to be comparable with the investigative phase). They compared similarities in participants' nonverbal and verbal behaviours when responding to baseline and investigative questions, using the two types of baselines. They found that liars and truth-tellers in the

small-talk baseline condition did not differ in their level of similarly between the baseline and investigative questions, adding further evidence to the ineffectiveness of this approach. Their results did, however, reveal that truth-tellers showed significantly more similarity than liars in the comparable baseline condition, though only in terms of spatial details. Finally, Caso, Palena, Vrij, and Gnisci (2019) looked at the effects of small-talk and comparable truth baselines on observers' deception detection accuracy. This study revealed that i) participants in the comparable truth condition outperformed those in the small-talk condition in terms of total accuracy rates (d = .49), and ii) only observers who used a comparable truth baseline performed significantly better than chance levels in their total accuracy for distinguishing truth-tellers from liars (d = .34).

Taken together, previous research on baselining shows that to enhance diagnostic accuracy, a comparable truth baseline should be used. That is, the baseline statement must be equivalent to the statement of interest in terms of content, time-frame, stakes, cognitive and emotional involvement, and questioning context (Caso et al., 2019; Ewens et al., 2014; Palena et al., 2018; Vrij, 2008). Despite the importance of the baseline statement being equivalent to the target portion of the statement, each of the previous studies compared the effect of an initial, separate baseline statement to a target portion of an investigative interview. Investigating whether a baseline statement could be derived from parts of the interviewee's statement could have important implications for practitioners who may be inclined to draw such comparisons between corroborated and uncorroborated portions of an interviewee's account.

5.2.1 The Present Study

The objective of the present study was to investigate whether introducing a within-statement baseline comparison could improve the accuracy of participants' veracity judgements. Participants read the alibi statement of a mock suspect and

provided a veracity judgement regarding a critical two-hour period within the alibi statement. This critical element was either deceptive or truthful and was embedded into an otherwise truthful story. I examined if providing an instruction to use a comparable baseline (i.e., informing participants that all information, with the exception of the critical statement, has been confirmed to be truthful) could enhance judges' detection accuracy. I hypothesised that participants who received the baseline instruction would have more accurate veracity judgements than participants who did not receive the baseline instruction.

5.3 Method

5.3.1 Participants

The sample consisted of 148 adult participants (120 females; 28 males) between the ages of 17 and 45 years (M_{age} = 20.53 years, SD_{age} = 3.17). The nationality of participants was German (n = 80), Dutch (n = 27), British (n = 1), or 'Other' (n = 40). The sample size was calculated prior to data collection by multiplying the total number of statements (n = 74) by two, ensuring that each statement was evaluated twice. Given this sample size, and an α of .05, I had an 85.6% chance of rejecting the null hypothesis if there was a medium effect size (f = .25; Cohen, 1988). Only participants who were proficient in reading and writing English were eligible for the study. They were compensated with either course credit or a €5 voucher. The study was approved by the standing ethical committee. The study was pre-registered and approved via the Open Science Framework (http://j.mp/2IjvL51).

5.3.2 Statements

The statements that participants evaluated were previously collected by the Principal Investigator (see Chapter 4). These statements represent accounts provided by student research participants who were instructed to provide alibi statements to

convince an interviewer that they were innocent of a hypothetical crime. For the present study, I incorporated the statements that were entirely truthful recollections of an interviewee's events on a particular day (n = 37), and the statements that were truthful accounts containing a lie from 1:00pm to 3:00pm (n = 37). For the latter group, interviewees truthfully reported their events on the day in question, before 1:00pm and after 3:00pm; however, during the critical element (i.e., between 1:00pm and 3:00pm) they were instructed to fabricate a particular activity. Thus, participants in the current study assessed one transcript that contained a critical element that was either deceptive (i.e., embedded into an otherwise truthful account) or truthful (i.e., part of an entirely truthful account). Each of the 74 statements was evaluated twice by two independent participants.

Ground truth. I attempted to establish partial ground truth of the statements by asking participants to self-report the truthfulness of both components of their statement (on a scale of one to ten, one being not at all truthful and ten being completely truthful). Truth-tellers reported that both their general alibi (M = 9.32, SD = 0.88) and the critical component (M = 9.59, SD = 0.90) were almost completely truthful. Those who provided the embedded lie reported that their general alibi was almost entirely truthful (M = 7.92, SD = 2.45) whereas the critical component was mostly deceptive (M = 2.62, SD = 2.48). The complete statistical analyses are reported in Chapter 4 (pp. 80-81). Overall, interviewees appeared to have largely conformed to the instructions they received across conditions.

5.3.3 Design

The experiment followed a between-subjects factorial design: 2 (Baseline instruction: Present vs. Absent) x 2 (Veracity of the critical element: Truth vs. Lie). Participants were randomly assigned to one of the four conditions. To mimic real-life

cases in which investigators typically only have one statement to assess, each participant judged only one statement. The dependent measure was the accuracy of participants' deception judgements. Two accuracy scores were created by recoding participants' binary and Likert scale truth-lie judgements with the ground truth of the veracity of the critical element.

5.3.4 Procedure

Participants arrived at the lab and provided informed consent. Afterwards, they received a detailed instruction letter (see Appendix D) explaining that their task was to imagine themselves in the role of a police detective who was investigating a violent burglary that occurred recently. Participants were told that the prime suspect was interviewed by police and had provided an alibi statement for the entire day in question, from morning to evening. They were informed that the critical element of the alibi was from 1:00pm to 3:00pm on this day. The critical element within each transcript was highlighted yellow to ensure this was clearly understood. Participants were instructed to read the entire statement carefully, but to make an assessment regarding the veracity of only the highlighted critical element. All participants were told that it was important to make the correct decision because it would earn them a chance to win €50 from a raffle.

Participants who were assigned to the Baseline-present condition received additional instructions prior to reading the transcript. They were informed that as the lead investigator, they had access to other sources of information for the case and this collateral evidence confirmed that the "general" alibi statement, before 1:00pm and after 3:00pm was truthful. Participants were instructed to use this knowledge to compare the "general" portion of the interviewees' alibi to the "critical element from 1:00pm to 3:00pm". They were asked to try to identify any patterns or changes in the

verbal content between the general alibi and the critical element that may indicate how credible the suspect's account was during the highlighted critical element.

After reading the instructions, all participants received one written transcript of a suspect's alibi statement and they were given up to ten minutes to read it. Subsequently, participants were prompted to provide a binary deception judgement (lie or truth) regarding the highlighted critical element. They also rated their deception judgment on a 7-point Likert scale (1 – completely truthful to 7 – completely deceptive). Once completed, participants responded to a short questionnaire that included a motivation check, general study experience questions[10], and demographics information (i.e., age, sex, race, native language and education). Upon finishing, participants were debriefed and the study was concluded. All participants were entered into the €50 raffle, regardless of the accuracy of their veracity judgments. Participation in the study took approximately thirty minutes.

To evaluate the accuracy of participants' veracity judgements, their scores were recoded in two ways. First, I recoded the binary truth-lie judgements with the ground truth of the veracity of the critical element. A score of 0 was assigned to incorrect veracity decisions whereas a score of 1 represented correct veracity decisions. Second, the Likert scale truth-lie judgements were organized based on the ground truth of the veracity of the critical element. Specifically, I mirrored the Likert values between conditions such that the following values were equal: one and seven, two and six, three and five, and four was neutral. In this way, all lower scores indicated more correct veracity judgements and all higher scores indicated less correct judgements.

[10] The general study experience questions were included as part of a larger multi-laboratory study on the subjective experience of psychology experiments.

Lastly, I also investigated participants' self-reported cues to perceived deception. The complete report of this coding and analysis can be found in Appendix D, and a brief overview of the findings will be provided in the Results section below.

5.4 Results

5.4.1 Motivation, Experimental Realism, and Self-Perceived Lie Detection Ability

On a series of 7-point Likert scales (1 = not at all, 7 = very), participants reported that they were highly motivated (M = 6.29, SD = 0.87), they answered the questions honestly (M = 6.82, SD = 0.45), the instructions were very clear (M = 6.49, SD = 0.80), and the alibi statements were realistic (M = 5.39, SD = 1.24), with no significant differences between baseline and veracity conditions ($F(3, 144) = 1.07$, $p = .366$, $\eta_P^2 = .022$; $F(3, 144) = 0.29$, $p = .830$, $\eta_P^2 = .006$; $F(3, 144) = 1.26$, $p = .290$, $\eta_P^2 = .026$; and $F(3, 144) = 0.35$, $p = .789$, $\eta_P^2 = .007$, respectively). Additionally, participants self-reported to be average lie detectors (M = 4.10, SD = 1.14), with no significant differences between baseline and veracity conditions, $F(3, 144) = 1.11$, $p = .345$, $\eta_P^2 = .023$.

5.4.2 Accuracy of Deception Judgements

The accuracy of participants' deception judgements was analysed using two-way between subjects ANOVAs. In addition, I conducted Bayesian ANOVAs with default prior scales, using JASP software. The Bayesian factors (*BF*; for interpretation, see Jarosz & Wiley, 2014; Lee & Wagenmakers, 2013) are reported in line with the guidelines by Jarosz and Wiley (2014), adjusted from Jeffreys (1961). The approximate evidence categories are as follows: Values between 1 and 3 indicate weak evidence for the alternate or null hypothesis, between 3 and 10 indicate positive/substantial evidence, between 10 and 20 constitutes strong/very strong evidence, and scores above 20 are considered very strong/decisive evidence. The interaction model within JASP combines

both main effects and the interaction effect; therefore, evidence for the interaction term individually was calculated by dividing the interaction model by the main factors (e.g., Wagenmakers et al., 2016). For ease of interpretation, BF_{10} is used to indicate the Bayes factor as evidence in favor of the alternative hypothesis, whereas BF_{01} is used to indicate the Bayes factor as evidence in favor of the null hypothesis.

Overall, the accuracy of participants' binary deception judgements, where 0 represents incorrect and 1 represents correct judgements, did not differ significantly from chance level (M = 0.53, SD = 0.50, $t(147) = 0.82$, p = .413, d = .06). To examine whether the baseline instruction increased judges' ability to accurately discriminate between lies and truths, I conducted a 2 (Baseline instruction: [present, absent]) X 2 (Veracity of the critical element: [truth, lie]) between-subjects ANOVA on the accuracy of participants' binary deception judgements. Contrary to my hypothesis, the main effect of the Baseline instruction was not significant ($F(1, 144) = 0.26$, p = .613, η_P^2 = .002; BF_{01} = 5.06), meaning that participants who received the Baseline-present instructions (M = 0.55, SD = 0.50, 95% CI [0.44, 0.67]) were not more accurate in their deception judgements than participants who received the Baseline-absent instructions (M = 0.51, SD = 0.50, 95% CI [0.40, 0.63]). This analysis revealed a main effect of the Veracity of the critical element ($F(1, 144) = 10.33$, p = .002, η_P^2 = .067; BF_{10} = 18.49), with lies (M = 0.66, SD = 0.48, 95% CI [0.55, 0.77]) being judged more accurately than truths (M = 0.41, SD = 0.49, 95% CI [0.29, 0.52]). Finally, the Veracity of the critical element by Baseline instruction interaction effect was also not significant ($F(1, 144) = 1.40$, p = .238, η_P^2 = .010; BF_{01} = 2.36), indicating that the baseline instruction had no differential effect on the accuracy of participants' deception judgements for lies and truths.

The overall mean accuracy of participants' lie-truth Likert judgements, where lower numbers indicate more correct judgements and higher numbers indicate more incorrect judgements, was 3.89 (*SD* = 1.54), and did not differ statistically from chance level, $t(147) = 1.81$, $p = .240$, $d = .10$. I conducted a 2 (Baseline instruction: [present, absent]) X 2 (Veracity of the critical element: [truth, lie]) between-subjects ANOVA on the accuracy of participants' Likert scale deception judgements. No significant differences emerged. I did not observe a significant main effect of the Baseline instruction, $F(1, 144) = 3.80$, $p = .053$, $\eta_P^2 = .026$; $BF_{01} = 1.01$ ($M_{\text{Baseline-present}} = 3.65$, *SD* = 1.52, 95% CI [3.30, 4.00] versus $M_{\text{Baseline-absent}} = 4.14$, *SD* = 1.52, 95% CI [3.79, 4.48]). Nor did I find a significant main effect of the Veracity of the critical element, $F(1, 144) = 1.42$, $p = .236$, $\eta_P^2 = .010$; $BF_{01} = 2.99$ ($M_{Lies} = 3.74$, *SD* = 1.50, 95% CI [3.39, 4.09] versus $M_{Truths} = 4.04$, *SD* = 1.57, 95% CI [3.69, 4.39]). Finally, the Veracity X Baseline interaction effect was not significant, $F(1, 144) = 0.95$, $p = .332$, $\eta_P^2 = .007$; $BF_{01} = 2.85$.

Cues to Deception

The majority of participants' open-ended responses regarding their cues to deception related to contradictions or inconsistencies, the presence of filler words, and the overall number of details. Participants across baseline conditions did not significantly differ in their use of cues related to differences between the baseline and critical period in terms of the amount of details or the type of details. I further examined participants' cue endorsement from a predetermined list of cues, finding that 'Consistency within the statement' was the most commonly reported cue (reported by nearly 68% of participants); however, there was no statistically significant difference between the instruction groups regarding the endorsement of this cue. The complete analyses can be found in Appendix D.

5.5 Discussion

It is well-documented that observed lie detection rates hover around 50% (e.g., Bond & DePaulo, 2006). I replicated this finding. Contrary to my hypothesis, I found that participants who were instructed to use a within-statement comparable baseline did not outperform the control group in terms of lie-truth discrimination accuracy. Additionally, I observed that participants across groups were significantly better, and above chance level, at detecting lies than truths.

The only previous study to examine how the comparable truth baseline affects observers' judgement accuracy found an enhanced detection ability with this technique (Caso et al., 2019). A possible explanation for these diverging findings lies in how the statements were generated. In Caso et al. (2019) interviewees reported about experimental tasks they had just completed. This study, in contrast, used statements about participants' experienced activities on the day in question. Consequently, my participants were mostly unconstrained in their reports. These paradigms differ systematically in the source of deception, which was either scripted by the researcher (Caso et al., 2019, i.e., a scripted task; Vrij, 2008) or drawn freely from the participant's own experience (current study, i.e., an autobiographical task; Sporer & Sharman, 2006). When lies are self-generated, the deceiver can elaborate with personal experience, whereas lies designed by the researcher cannot be so easily embellished. As a consequence, it is possible that the statements resulting from the different sources of deception were perceived differently by the lie-detectors. Scripted tasks, relative to autobiographical tasks, may have been more straightforward to evaluate, which perhaps contributed to the incongruent findings between the present study and that of Caso et al. (2019). A second explanation for these results could be derived from my ground truth manipulation check. Compared to interviewees who reported entirely truthful recollections of their day, interviewees who embedded a lie reported lower ratings of

truthfulness for the general, truthful portion of their statement (Mean difference significant at $p = .002$). Thus, the truthful baseline of liars' statements may have been more comparable with their lies, which could have weakened lie-detector's ability to make accurate decisions.

The analysis of the binary deception judgements allows for a direct comparison to the results of previous work (Caso et al., 2019). This analysis revealed no effect of the baseline instruction with a Bayes Factor indicating substantial evidence. To directly compare to previous research, I also calculated a Cohen's d effect size, which reaffirmed a very small effect ($d = 0.08$) of the baseline instruction on participants' binary judgements. The finding from the Likert judgements are, however, more ambiguous. This measure also indicated no effect of the baseline instruction, with a p value of .053 and was accompanied by an inconclusive Bayes Factor. This pattern suggests that although I did not find evidence that the within-statement baseline comparison was an effective lie detection tool, I also cannot rule out that it may have an effect that was too small for my study to pick up. Future research should replicate this study with an increased sample size. Although my power analysis indicated that I had sufficient power to detect an effect size of similar nature of Caso et al. had it been present, I may have been underpowered to detect a smaller effect size.

Contrary to previous research (e.g., Bond & DePaulo, 2006; Vrij, 2008), participants in this study did not display a tendency towards truthful decisions in their binary veracity judgements. In fact, participants showed a lie bias; participants were significantly better at classifying lies compared to truths. This lie bias could be related to my study being advertised as a police investigation and lie detection experiment, which may have biased the sample into expecting deceptive accounts. Similar lie biases have been observed among police officers (e.g., see Meissner & Kassin, 2002 for a

review). It is also worth mentioning that participants in this study made only one veracity judgement and therefore could not calibrate their decisions to truth-lie base rate expectancies (e.g., Street & Richardson, 2015), also potentially explaining the lie bias.

5.5.1 Limitations and Future Research

In this study, I examined the efficacy of a comparable truth baseline derived from different parts within an interviewees' statement. This paradigm may accurately reflect real-world conditions in which interviewees interweave truths and lies (e.g., Vrij, 2008), but it tests only one specific type of baselining. This type of baselining employs a within-subjects comparison, which is already superior to other between-subjects lie detection comparisons (Vrij, 2016) since it controls for individual variation in reporting (e.g., some people talk more than others; Merckelbach, 2004; Nahari & Pazuelo, 2015; Vrij, Akehurst, Soukara, & Bull, 2002). A limitation, however, is that this type of baselining fails to control for the situation. Some events are richer in detail than others, which could explain the null findings observed in the present study.

Future research should establish baselines that control for both the individual and the situation. Examples of this type of baselining already exist (Vrij, 2016; Vrij, Leal, & Fisher, 2018). For instance, the Model Statement (MS) technique can be used as a within-subjects technique, as done by Leal and colleagues (2018). With this approach, the interviewee first provides a freely recalled report about the event under investigation (the baseline statement). Then, they receive a MS, after which they again provide a free recall account, this time considering the amount of detail within the MS. Investigators can then look for deviations in the types of details (e.g., complications or peripheral information) provided in the second statement, relative to the initial, baseline statement (Vrij et al., 2018). Another example is to use the reverse order technique.

That is, investigators could invite interviewees to first freely report what they have experienced, and afterwards ask them to again report the event again but in reverse order. Investigators can then pay attention to any reminiscences or contradictions between the two statements (e.g., Vrij, 2016). Future research should continue exploring avenues of verbal baselining, specifically those that control for both the individual and the situation.

Another point worth considering is that investigators in our study were naïve university students, who likely did not have previous experience in conducting credibility assessments. This lack of experience and training may have impaired their ability to make accurate veracity decisions, and perhaps different results would be obtained if the same experiment was conducted with seasoned police or intelligence officers, particularly those who have experience with baselining techniques. Although, lie detection accuracy is typically not better for professional lie-detectors (e.g., police officers) than it is for laypersons (Bond & DePaulo, 2006) and the results of the current study therefore may extend beyond the laboratory to professional credibility assessors. This avenue should be tested with future research.

5.5.2 Conclusion

In sum, I did not find evidence that the within-statement baseline technique can enhance deception detection accuracy. The type of verbal baselining tested in this study thus appears to be most effective when the comparable truth baseline is established prior to the investigative portion of the statement. Future research should prioritise verbal baselining techniques that account for both the individual and the situation.

Chapter 6:
General discussion

6.1 General Discussion

To date, most deception research experimentally presumes that veracity is a dichotomous factor. This is despite the growing body of evidence that truthful and deceptive information often exist within the same statement (e.g., Leins et al., 2013, 2017; Nahari, 2018a; Nahari & Vrij, 2015). Accordingly, the overarching aim of the current thesis was to provide an empirical examination of lies that are embedded into truthful statements. In particular, the studies conducted within this thesis explored three factors: (i) how individuals who describe themselves to be good liars use strategies to successfully evade detection, (ii) to what extent embedded lies affect the verbal quality of statements, and (iii) if embedded lies can be exploited to facilitate lie detection within statements. A key aim of this research was to address concerns regarding the potential threat of embedded lies to the reliability and diagnostic accuracy of criteria derived from commonly used verbal credibility assessment tools, such as detail richness.

This discussion section provides an overview of the key findings and a consideration of the theoretical and practical implications. Some of the limitations of the current research are presented as well as avenues for future research.

6.1.1 Summary of Findings

To address the first aim of my research, this thesis began by exploring how self-reported good liars use strategies to successfully evade detection. Meta-analytic findings indicate that the success of uncovering a deceptive interaction depends more on the liar than on the lie detector (e.g., Bond & DePaulo, 2008). Yet, little is known about what enables good liars to evade detection. Thus, the primary aim of the research presented in Chapter 2 was to explore the lie prevalence and deception strategies of self-reported skilled liars. My results replicated earlier research that a minority of individuals account for the majority of lies told in daily life, and I found evidence that

these prolific liars also consider themselves good liars. Importantly, I also observed that self-reported good liars use verbal strategies of deception, with their most common strategy being to embed lies into truthful stories. This chapter highlighted the importance of developing strategy-based interventions that account for the strategic embedding of lies, particularly by skilled liars.

Next, I examined how embedded lies may affect the verbal quality of statements. Chapter 3 reported an experimental examination of how interviewees strategically regulate the information they provide when their accounts contain both truths and lies. I found that interviewees calibrate the richness of detail provided in the first element of their statement based on the veracity of the following element, such that elements followed by a lie were less detailed than elements followed by a truth. Moreover, I showed that lies become more detailed when they are flanked by truthful information compared to when they are flanked by other lies, meaning that interviewees also calibrate their lies according to both the preceding and the following element. The findings reported in this chapter suggest that when statements contain both truthful and deceptive components, liars are able to strategically calibrate the richness of detail.

Given the calibration evidence, the following study (Chapter 4 of this thesis) manipulated statements to contain lies embedded into truthful statements. I then investigated whether embedded lies differed qualitatively compared to full fabrications. This study revealed that lies embedded in otherwise truthful statements did not differ from lies embedded in deceptive accounts in terms of, for example, the richness of detail and verifiability of information. Moreover, I showed that embedded lies could be distinguished from truthful statements based on detail richness and statement quality (i.e., clarity and plausibility). Based on these findings, verbal credibility assessment

tools (e.g., CBCA and RM) that rely on the verbal content measured in this study appear to be robust against the embedding of lies.

Chapter 5 addressed the final aim of this thesis: Understanding if embedded lies can be exploited to facilitate lie detection within statements. I expanded on earlier research on the baseline technique by exploring whether introducing a within-statement verbal baseline comparison could enhance discriminatory accuracy between lies and truths. The results suggested that instructing participants to make a within-statement baseline comparison did not improve the accuracy of deception detection. This chapter thus informed our understanding of within-statement lie detection, with applied relevance given police officers' potential reliance on similar techniques during investigations.

6.1.2 Insights for Detecting Deception

6.1.2.1 Truths and lies within statements. The findings of the current research lend support to the small body of earlier work showing that, when given the opportunity, liars will incorporate as much truthful information as possible into their accounts (e.g., Leins et al., 2013, 2017; Nahari, 2018a; Nahari & Vrij, 2015; Nahari et al., 2014b; Vrij, 2008; Vrij, Granhag, & Porter, 2010). In theory, if liars draw on their memory traces of truthful previous experiences to report perceptual and contextual information, then their statements may resemble those of truth-telling interviewees. In turn, this could affect verbal credibility assessment tools that are derived by the assumption that lies have different content patterns than do truths (e.g., CBCA and RM). This thesis provided evidence that self-reported good liars report embedding their lies as a strategy for successfully deceiving (Chapter 2). I also showed that when lies are flanked by truthful information, they become more detailed (relative to when they are flanked by more deceptive information; Chapter 3). A promising finding – that

speaks to the robustness of verbal veracity assessment tools such as CBCA and RM against embedded lies – was that lies embedded in truthful stories did not differ qualitatively from lies that were incorporated into fully fabricated statements on a number of cues (e.g., detail richness and verifiability of information; Chapter 4). This finding strengthens earlier work showing that verbal lie detection tools are still effective even when liars incorporate previous experiences (Gnisci et al., 2010; Valois et al., 2019), which has relevance for deception scholars and legal professionals alike.

Two of my experimental studies involved the production of lies. I instructed participants to fabricate their stories (Chapters 3 and 4), yet I found evidence that their lies were blended with truthful information. In Chapter 3, participants across veracity conditions reported to have strategically included truthful details that they had drawn from previous experiences and/or memory, meaning that I had deceptive statements that were likely a combination of truths and lies. Similarly, in Chapter 4, the self-reported truthfulness ratings revealed that liars instructed to fabricate their entire account reported still including some truthful information, and the embedded liars reported that their general statement was mostly truthful, but still included some lies. These findings, although somewhat difficult to disentangle in an experimental sense, contribute further evidence that liars provide statements that are a blend of truths and lies.

It is possible that a clearer instruction to invent their stories entirely from imagination could have made more explicit that lies should not be drawn from previous experiences. However, one may wonder what effect such an explicit instruction would result in. It may resemble the well-known observation that when asked to not think of a pink elephant, people will almost invariably think of a pink elephant once their attention has been drawn to it (e.g., Lane, Groisman, & Ferreira, 2006). This example

serves to illustrate that people may not have total control over what thoughts come to mind. Although many theories of deception have presumed that lies and truths result from different production processes (e.g., the theoretical groundwork for CBCA and RM), it is also possible that lies are typically built from variations of the truth or a related episodic memory of an event, either personally or vicariously experienced (Walcyzk, Harris, Duck, & Mulay, 2014). This paradigm would suggest that instead of liars carefully selecting units of information to include in their lies, lies might be constructed from the most readily accessible information within their working and/or long-term memory (McCornack, Morrison, Paik, Wisner, & Zhu, 2014). Indeed, some have argued that truths and lies stem from the same speech production system (Mohamed et al., 2006; Walczyk et al., 2014). Thus, more generally, when we ask participants to lie in our experiments, they may simply draw on the first thing that comes to mind, which is likely to be a previous experience.

Given the prevalence at which liars admit to including truthful information within their deceptive reports, in combination with previous research findings (Leins et al., 2013) and those presented in this thesis, it is feasible that researchers have already been inadvertently examining embedded lies. That is, rather than comparing the extent to which truthful statements differ from deceptive statements, perhaps we have been investigating the differences between truthful accounts and partial lies that are under the guise of complete fabrications. This also offers a possible explanation as to why lies and truths are notoriously difficult to differentiate. If guilty suspects provide statements that are predominantly truthful, with only a few self-incriminating aspects modified, then it further complicates the credibility assessors' task (Gnisci et al., 2010; Vrij, 2008a). Even so, supposing that deception research has already been examining lies that are embedded with truth, it stands to reason that the findings from the general

deception literature also pertain to embedded lies. For example, it was previously shown that CBCA and RM are effective tools as, with appropriate training, evaluators' accuracy rates increase from chance level to between 65% and 80% (Vrij, 2008a). Indeed, this finding may be the product of studies that were distinguishing truthful statements from deceptive statements that contained truthful information. If that is the case, I can speculate that these tools may be effective whether the lie has been invented entirely or based upon a previous truthful experience.

In fact, research from this thesis demonstrated that embedded lies do not differ qualitatively from full fabrications, at least on a subset of criteria (Chapter 4). These lies embedded in otherwise truthful statements could be distinguished from truths embedded in truthful statements, which is comparable to the results of a previous study that examined how lies differ when they are invented or based on previous experience (Gnisci et al., 2010). In both studies (i.e., Chapter 4 of this thesis and Gnisci et al.'s 2010 experiment), even when liars incorporated truthful, previously experienced information into their fabrications, differences still existed between the deceptive and truthful elements. Similarly, in their unpublished work, Valois and colleagues (2019) examined whether CBCA and RM techniques could differentiate both fully and partially deceptive accounts from truthful accounts. They found that both tools were still effective even when interviewees incorporated truthful events into fabricated accounts.

If previous deception studies have already encompassed embedded lies, it brings into question the relevance of this doctoral research. The purpose of my line of research was to empirically investigate the extent to which the strategic embedding of lies influences the verbal behaviours of liars, to define the qualitative manifestations of this strategy, and to introduce possible ways to exploit these manifestations to increase

lie detection accuracy. My discussion will now turn to the latter two factors: Defining and exploiting the qualitative manifestation of embedded lies.

6.1.2.2 An extension to the consistency framework. Much of the research presented in this thesis is grounded in the idea that liars are highly concerned with maintaining consistency within their statements (e.g., Deeb et al., 2017, 2018; Hartwig et al., 2010). Whilst the majority of previous research regarding consistency has referred to factual content, Deeb et al. (2017) provided empirical evidence that liars' attempts to maintain consistency generalise to other situations (i.e., including fewer repetitions in specific parts of their interview). Moreover, Leins et al. (2017) provided anecdotal evidence that liars' draw on previous experiences to report statements detailed in, for example, spatial information. The results of my first experiment (Chapter 3) contributed further evidence that liars' attempts to maintain consistency extend beyond the factual content and can influence the richness of detail provided. A notable finding was that liars calibrated the detail richness of their lies to be consistent with that of their truths.

However, when I extended the paradigm to include lies that were embedded into truthful information (Chapter 4), the pattern of consistency faded. That is, the lack of difference between the two types of lies suggested that embedded liars were not able to maintain consistency within the truthful and fabricated components of their statements, since the lies did not become more detailed to mirror the truths. Moreover, the truthful (non-target) portions of the statements were similarly rich in detail, regardless of whether the statement was entirely truthful or contained an embedded lie. It is possible that, if liars had specific knowledge of the criteria indicative of truthfulness, they may have been better able to produce a fabricated element that was comparable in detail and quality to the truthful component.

The research conducted in this thesis attempted to define the qualitative manifestations of the embedding strategy through the lens of consistency. Taking these findings together, I found contradictory evidence regarding how liars manage the consistency of details between truths and lies within statements. A possible explanation as to why I observed the consistency effects in Chapter 3, but not in Chapter 4, relates to the cognitive load of liars. In the first experiment (Chapter 3), I examined the effect of two elements immediately following each other, whereas my next study (Chapter 4) examined a more true-to-life scenario in which a lie was embedded into an otherwise truthful alibi statement. It may have been easier for liars to calibrate the richness of details they provided when they could compartmentalise their reports about the two distinct, and brief, tasks (Chapter 3). In contrast, it may have been more cognitively demanding for liars to monitor the information they provided throughout a longer, more dynamic statement (Chapter 4). This additional cognitive load could have impaired liars' ability to strategically regulate the consistency of details between their truths and lies. Still, this pattern of results goes against common sense, as it would presumably be easier for liars to draw on their truthful memories when embedding a lie into their otherwise autobiographical memory versus when reporting a scripted task. Nonetheless, if the additional cognitive pressure of selectively drawing from memory traces does weaken liars' ability to maintain consistency within statements, it could mean that real-world liars are unable to provide high quality, consistently detailed accounts when using embedded lies. This would contribute additional support to the reliability of verbal credibility assessment tools for distinguishing both fully and partially fabricated accounts from truthful accounts.

Another possible explanation is that I am observing the "decline effect," whereby early empirical investigations show the strong presence of a phenomenon, but

later studies show diminishing or nonexistent effects (Schooler, 2011). This would not be entirely unsurprising given the replication crisis currently topical in the field of psychological science (Open Science Collaboration, 2015). Still, future research should continue exploring this extension of the consistency framework, given that both liars and legal professionals associate consistency with veracity (e.g., Deeb et al., 2017; Hartwig et al., 2010; Vredeveldt et al., 2014). Advancing our knowledge on consistency, or other potential qualitative indicators of embedded lies, is beneficial for designing strategy-based methods for exploiting these types of lies.

6.1.2.3 Exploiting embedded lies to facilitate deception detection. Research conducted in this thesis was, to my knowledge, the first to examine whether introducing a baseline comparison that was derived from multiple different parts of an interviewees' statement could facilitate the detection of lies (Chapter 5). My paradigm provided an individual-level comparison and simultaneously allowed the opportunity to test whether embedded lies could be exploited to facilitate lie detection. Contrary to my hypothesis, I found that participants who were instructed to use a within-statement comparable baseline did not outperform the control group in terms of lie-truth discrimination accuracy. This is in opposition to the findings of the only previous study to examine how the comparable truth baseline affects observers' judgement accuracy (Caso et al., 2019).

An important factor to consider is that the paradigm I tested, while controlling for variation at the individual level, did not control for varying events throughout the statement. A preferable method of verbal baselining is to generate baseline comparisons that control for *both* the individual and the situation (Vrij, 2016). Examples of this type of baselining could be to first have interviewees freely recall an event in chronological order and then to have them recall the same event in reverse order (Vrij, Leal, Mann, &

Fisher, 2012), or to obtain a free recall, administer a Model Statement, and then obtain a second statement of the same event (Leal et al., 2018). With these types of comparisons, investigators can look for deviations in the types of details (e.g., reminiscences, contradictions, complications or peripheral information) provided in the second statement, relative to the initial, baseline statement (Vrij, 2016; Vrij, Leal, & Fisher, 2018). Additional within-subjects alternatives could be to evaluate the proportion of verifiable details (Nahari et al., 2014b; Vrij, 2016) or complications (Vrij, Leal, Jupe, & Harvey, 2018) during an interviewees' statement regarding an event. Future research should continue exploring avenues of verbal baselining that control for both the individual and the situation.

The rationale for believing that such baseline comparisons could help to exploit embedded lies relates to my consistency framework. It is possible to manipulate the cognitive load or cognitive flexibility of liars, for instance, by changing the report mode (e.g., Leins, Fisher, Vrij, Leal, & Mann, 2011) or employing the reverse-order technique (e.g., Vrij et al., 2017). Such methods have shown to enhance deception detection based on statement consistency (Leins, Fisher, & Vrij, 2012; Vrij, 2016). Specifically, introducing unanticipated changes in question format – such as asking suspects for an oral account and then for a sketch (Leins et al., 2012; Leins, Fisher, Vrij, Leal, & Mann, 2011) or asking for a reverse order narration after a chronological report – reduces the levels of consistency in liars' statements more than in truth-tellers' statements.

These techniques aid truth-tellers in retrieving additional information about an event as they remember it from a different perspective, so called reminiscences (e.g., Leins et al., 2012). In contrast, realising that consistent accounts are more likely to be perceived as credible, liars are likely to repeat their first statement without adding any

new information (e.g., Vrij, 2016). Moreover, the complexity of reporting information in reverse order or via drawings may also generate more errors from liars in the form of contradictions between the two statements (Vrij et al., 2012). Thus, using within-subjects comparisons that exploit liars' attempts at maintaining consistency show promise as an avenue for deception detection, and it would be highly useful for future research to test these comparisons explicitly with embedded lies.

6.1.3 Practical Implications

The main practical implications from this thesis relate to the use of verbal credibility assessment tools and within-statement methods of deception detection. Based on the research conducted in this thesis, several recommendations can be offered to practitioners who conduct credibility assessments.

CBCA is one of the most widely used credibility assessment techniques worldwide, and can be used as evidence in some courts in North America and in European countries such as Germany and Sweden (Verschuere, Vrij, & Granhag, 2015). In the absence of evidence that embedded lies may jeopardise the efficacy of verbal veracity assessment techniques (e.g., Chapter 4 of this thesis; Gnsici et al., 2010; Valois et al., 2019), my tentative recommendation is for legal practitioners to continue using these tools as an investigative aid. This recommendation comes with two caveats. First, practitioners should be particularly cautious making verbal credibility assessments during circumstances in which interviewees could easily draw upon truthful previous experiences. Although embedded lies may not render tools such as CBCA and RM entirely ineffective, these lies do have the potential to interfere with classificatory accuracy. Second, practitioners should prioritise richness of detail (i.e., the level of detail or amount of specific information included in a statement) as a cue to deception

during statement analysis as this is one of the only robustly validated cues within the literature (e.g., Luke, 2019).

Another practical implication relates to within-statement lie detection. Practitioners have repeatedly made valid requests for lie detection techniques to incorporate within-subjects comparisons; however, such comparisons are not very prevalent in the non-verbal and verbal lie detection fields (see Vrij, 2016 for a discussion). Evidence in this thesis (Chapter 5) showed that a within-statement verbal baseline comparison may not be an effective lie detection tool. This finding has applied relevance given police officers' potential reliance on similar techniques during investigations (e.g., Ewens et al., 2014; Frank et al., 2006; Inbau et al., 2013; Russano et al., 2014). Based on these results, I would caution investigators from drawing comparisons between corroborated and uncorroborated portions of an interviewee's account in the same manner that I did. Instead, I recommend that practitioners utilise methods of baselining that control for both the individual and the situation, as outlined above.

6.1.4 Methodological Considerations

The research conducted in this thesis pertains to a specific type of embedded lie. To gain insight into liars' verbal behaviour and strategies when providing a mixture of truthful and deceptive information, I was particularly interested in examining deceptive events that were incorporated into truthful stories. This differs from other variations of embedded lies that may involve, for example, the omission of critical information without the offer of an alternative explanation, or embedded lies that contain only a small deceptive fragment (such as the date an activity occurred, or a substitution of the perpetrator) whilst the remainder of the account remains truthful. In these latter variations of embedded lies, the interviewee does not provide a substantial

lie and it thus becomes difficult to evaluate content-based cues within the truthful and deceptive portions of their statement. The extent to which these types of embedded lies may influence verbal lie detection tools thus remains unknown. I could speculate that these sorts of embedded lies are particularly problematic since the statements are realistically nearly entirely truthful. In another vein, mixed veracity statements are not solely provided by guilty individuals trying to evade detection. Innocent interviewees may also incorporate lies into their otherwise truthful stories for a variety of reasons, such as impression management (e.g., Colwell et al., 2018; Clemens & Grolig, 2019). Lying by innocent suspects might lead to statement inconsistencies that are interpreted by investigators as cues to deception, thereby increasing their risk of being wrongfully assessed as guilty for a crime they did not commit. Future research should expand upon the research conducted in this thesis to account for various other types of embedded lies, including those from both the perspectives of guilty and innocent interviewees.

Two of my three experiments relied heavily on the verbal coding of statements. Although this is a favored methodology in verbal deception research, it is not without limitation. Guidelines exist for coding content-based cues, but there are a number of degrees of freedom afforded to researchers' development and execution of their own coding schemes. With this freedom comes the potential for a lack of consistency between different deception labs. In my studies, I reported moderate to high inter-rater reliability, suggesting that the consistency between raters was sound. However, there is still a possibility that different researchers may have drawn different conclusions from the same data set, had their coding criteria differed. This is a problem that relates to verbal lie detection research in general, and future work should develop more stringent and transparent guidelines for content-based coding that would help alleviate these issues. Researchers have proposed several ways to improve consistency in this field: (i)

by requiring laboratories to specify their coding schemes and to make these, and other training materials, publically available; (ii) by organizing a cross-laboratory collaboration to examine the reliability and validity of various coding methodologies; and (iii) by searching for ways to combine automated scoring systems with human-driven, contextually-based methods (Nahari et al., 2019). Doing so would increase the reliability and generalisability of content-based deception research.

A focus of the current thesis was on interviewees' strategies. I conducted extensive qualitative coding and analyses to open-ended responses from participants in Chapters 2, 3, and 4. My intention was to conduct a broad exploration of people's strategies in a variety of contexts, to inform our understanding of liars' metacognitions about deceiving. In theory, these insights could then be exploited in strategy-based lie detection techniques. However, this research method yielded less informative data than expected. Although I obtained a wide variety of responses at the individual level, my coding process required the reduction of responses into a practical number of categories that could be submitted to statistical procedures and that would produce meaningful results. This methodology led to the elimination of the more nuanced and informative units of data, and instead generated broader, less insightful categories of strategies. The data from my multiple-response questions regarding strategy use, however, were more informative and aligned to the behavioural data. Future research should prioritise directed questions regarding interviewees' strategies, and different qualitative coding methodologies may also be preferred.

More generally, there are constraints to the generalisability of the experimental research conducted within this thesis (Chapters 3, 4, and 5). In particular, my experiments relied on samples of motivated university students. A drawback of this sample is that the findings may not be representative of the population in general, and

therefore may not generalise beyond academic settings to legal contexts. Another common criticism of laboratory-based deception research is that researchers typically instruct people to lie, whereas in real-life, people presumably elect whether to lie or tell the truth as well as the topics of those reports (e.g., Kanwisher, 2009). Despite the artificiality of laboratory experiments, the primary advantage of this research methodology is the internal validity – that is, the ability to draw causal conclusions. To complement this work, future research should attempt to address these generalisability concerns by expanding to more ecologically valid scenarios that, for example, examine the verbal patterns and strategies of experienced criminals and involve designs in which interviewees can autonomously decide whether or not to lie, the topic of their report, and how and when to deliver their lie during their statements.

6.1.5 Overview of Future Research

The research presented in this thesis is intended as a starting point, which should be expanded to contexts that more closely resemble real-life credibility assessments; for instance, when statements have lies and truths dispersed throughout or during more dynamic interview scenarios. Various concepts could be explored in further studies to help develop our understanding of embedded lies. Some of these future research ideas have been addressed in the current chapter, and others have been provided in the discussion sections of Chapters 2, 3, 4, and 5. Bringing together the findings of this thesis, I will provide several final suggestions for future work on this topic.

The research conducted within this thesis revealed an important finding for deception researchers: Verbal credibility assessment tools that are based on the criteria measured in this research, appear to be robust against the embedding of lies. According to my research findings, it seems that although liars may attempt to maintain consistency in terms of the verbal quality of their truths and lies, their ability to do so

may not be strong enough to undermine the theoretical foundations of tools such as CBCA and RM. Additional research is necessary to replicate these results, and should extend these findings by evaluating the full set of CBCA and RM criteria, by incorporating more realistic crime simulations, and by testing professional lie detectors' ability to distinguish between partially and fully fabricated lies using the complete CBCA and RM protocols.

In this thesis, I have raised the suggestion that deception researchers may have already been examining embedded lies. Underlying most verbal lie detection research is the assumption that lies and truths stem from different production processes (e.g., the theoretical groundwork for CBCA and RM). Instead, lies might be constructed in a process similar to that of truths – by drawing on readily accessible information in memory. Future research should further investigate precisely how liars draw on their memory traces to produce embedded lies. Insight on this topic could be informative not only for developing ways to exploit such lies, but to also spur new theoretical ideas to account for differences between truths and lies, even if both production processes relate to truthful previous experiences.

Much of the research in this thesis examined detail richness. Deception researchers acknowledge that cues to deception are generally weak but that a handful of cues can significantly distinguish between truthful and deceptive messages (DePaulo et al., 2003; Hartwig & Bond, 2011). However, the estimated effect sizes of deception cues may be artificially inflated by publication bias, low power, and small numbers of estimates (Luke, 2019). One of the only cues to deception that has a trustworthy body of evidence is the level of detail within a statement (Luke, 2019). Researchers have also reported the level of detail as a significant determinant of veracity when considering

partially or fully fabricated statements (Nahari et al., 2012). A general recommendation is for researchers to continue emphasising the level of detail as a cue to deception.

The research conducted in this thesis also exemplified the importance of digging deeper into the strategic embedding of lies for the purposes of lie detection. Being aware of interviewees' strategy use is the first step towards altering and exploiting it. As such, this thesis calls for an increased focus on the development of lie detection methods that aim to exploit interviewees' strategic inclusion of truths and lies within statements. For instance, it is possible that applying empirically validated strategy-based techniques to smaller units of analysis within a single statement could be an effective step towards detecting and exploiting embedded lies. Recent research tested the efficacy of a Theme-Selection approach to detecting which part of a statement included a lie, finding that this within-subjects measure yielded stronger results than examining typical between-subjects differences of liars' and truth-tellers' entire interviews (Palena et al., 2019). Similarly, drawing from the computational linguistics field, Bachenko et al. (2008) developed a tagging system that discriminated between deceptive and non-deceptive passages within a written narrative. Deception researchers should focus their efforts on developments of this kind since they could allow for investigators to pinpoint deceptive hotspots within a statement, which would be highly advantageous for informing where to devote their investigative efforts. The recognition of deceptive hotspots, or potential signs of deception within a statement, could also encourage the acquisition of additional information (i.e., by further questioning, considering alternative scenarios, or focused investigative efforts to obtain evidence), thereby reducing the tendency to immediately interpret symptoms of deception as indicative of guilt (Vrij, Granhag, & Porter, 2010).

A general recommendation, therefore, is for both researchers and practitioners to move away from making global judgements of veracity; that is, deciding if an

interviewee in the case at hand is honest versus deceptive, or guilty versus innocent. Instead, lie detectors would benefit from a shift towards making discrete deception judgements, whereby the veracity of individual details is evaluated over the course of a statement (e.g., Leins et al., 2017). This type of evaluation is necessary to reflect the strategic behaviours of liars who interweave truths and lies, as evidenced by the research conducted in this thesis.

6.1.6 Conclusion

Across three experiments and one survey, this thesis examined how interviewees' strategic inclusion of truthful and deceptive information within a single account may affect statement quality, and the subsequent effects for methods of verbal lie detection. I found that liars strategically maintain consistency regarding the quality of information provided between truths and lies within their statement; however, their attempts at maintaining consistency do not appear to jeopardise the efficacy of several criteria derived from content-based verbal credibility assessment tools. This thesis emphasises that lie detectors should exploit liars' attempts at maintaining consistency by utilising methods of verbal baselining that control for both the individual and the situation. More generally, this thesis suggests that future research should broaden the discourse of deception from a truth-lie dichotomy to instead reflect that the amount of truthful and deceptive information within statements exists on a continuum.

References

Alison, L., Alison, E., Noone, G., Elntib, S., Waring, S., & Christiansen, P. (2014). Whatever you say, say nothing: Individual differences in counter interrogation tactics amongst a field sample of right wing, AQ inspired and paramilitary terrorists. *Personality and Individual Differences*, 68, 170–175. doi: 10.1016/j.paid.2014.04.031

Alonso-Quecuty, M. L. (1992). Deception detection and reality monitoring: a new answer to an old question? In F. Lösel, D. Bender and T. Bliesener (Eds.), *Psychology and Law: International Perspectives* (pp. 328–332). Berlin: Walter de Gruyter.

Alonso-Quecuty, M. L. (1995). Detecting fact from fallacy in child and adult witness accounts. In G. Davies, S. Lloyd-Bostock, M. McMurran and C. Wilson (Eds.), *Psychology, Law and Criminal Justice. International Developments in Research and Practice* (pp. 74–80). Berlin: Walter de Gruyter.

Amado, B. G., Arce, R., Fariña, F., & Vilarino, M. (2016). Criteria-Based Content Analysis (CBCA) reality criteria in adults: A meta-analytic review. *International Journal of Clinical and Health Psychology*, *16*, 201–210. doi: 10.1016/j.ijchp.2016.01.002

Bachenko, J., Fitzpatrick, E., & Schonwetter, M. (2008). Verification and implementation of language-based deception indicators in civil and criminal narratives. In Proceedings of the 22nd International Conference on Computational Linguistics-Volume 1: 41–48. Association for Computational Linguistics. Retrieved from: http://dl.acm.org/citation.cfm?id=1599087. doi: 10.3115/1599081.1599087

Bell, K. L., & DePaulo, B. M. (1996). Liking and lying. *Basic and Applied Social Psychology, 18,* 243–266. doi:10.1207/s15324834basp1803_1

Blair, J. P., Reimer, T. O., & Levine, T. R. (2018). The role of consistency in detecting deception: The superiority of correspondence over coherence. *Communication Studies, 69,* 483-498. doi:10.1080/10510974.2018.1447492

Bogaard, G., Meijer, E. H., Vrij, A., & Merckelbach, H. (2016). Strong, but wrong: Lay people's and police officers' beliefs about verbal and nonverbal cues to deception. *PLoS One, 11,* e0156615. doi:10.1371/journal.pone.0156615

Bond, J. C. F., & DePaulo, B. M. (2006). Accuracy of deception judgments. *Personality and Social Psychology Review, 10,* 214–234. doi:10.1207/s15327957pspr1003_2

Bond, J. C. F, & DePaulo, B. M. (2008). Individual differences in judging deception: accuracy and bias. *Psychological Bulletin, 134*, 477–92. doi: 10.1037/0033-2909.134.4.477 PMID: 18605814

Bond, J. C. F., Kahler, K. N., & Paolicelli, L. M. (1985). The miscommunication of deception: An adaptive perspective. *Journal of Experimental Social Psychology, 21*, 331–345. doi:10.1016/0022-1031(85)90034-4

Boskovic, I., Bogaard, G., Merckelbach, H., Vrij, A., & Hope, L. (2017) The Verifiability Approach to detection of malingered physical symptoms, *Psychology, Crime & Law, 23*, 8, 717–729. doi:10.1080/1068316X.2017.1302585

Brandt, D. R., Miller, G. R., & Hocking, J. E. (1980a). Effects of self-monitoring and familiarity on deception detection. *Communication Quarterly, 28,* 3–10.

Brandt, D. R., Miller, G. R., & Hocking, J. E. (1980b). The truth deception attribution: Effects of familiarity on the ability of observers to detect

deception. *Human Communication Research, 6,* 99–110. doi:10.1111/j.1468-2958.1980.tb00130.x

Brandt, D. R., Miller, G. R., & Hocking, J. E. (1982). Familiarity and lie detection: A replication and extension. *Western Journal of Speech Communication, 46,* 276–290. doi:10.1080/10570318209374086

Casler, K., Bickel, L., & Hackett, E. (2013). Separate but equal? A comparison of participants and data gathered via Amazon's MTurk, social media, and face-to-face behavioral testing. *Computers in Human Behavior*, *29,* 2156–2160. doi:10.1016/j.chb.2013.05.009

Caso, L., Palena, N., Vrij, A., & Gnisci, A. (2019). Observers' performance at evaluating truthfulness when provided with comparable truth or small talk baselines. *Psychiatry, Psychology and Law,* 1–9. doi:10.1080/13218719.2018.1553471

Chan, D. (2009). So why ask me? Are self-report data really that bad. *Statistical and methodological myths and urban legends: Doctrine, verity and fable in the organizational and social sciences,* 309–336.

Clemens, F., Granhag, P. A., & Strömwall, L. A. (2013). Counter-interrogation strategies when anticipating questions on intentions. *Journal of Investigative Psychology and Offender Profiling, 10,* 125–138. doi:10.1002/jip.1387

Clemens, F., & Grolig, T. (2019). Innocent of the crime under investigation: Suspects' counter-interrogation strategies and statement-evidence inconsistency in strategic vs. non-strategic interviews. *Psychology, Crime & Law,* 1–35. doi:10.1080/1068316X.2019.1597093

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, N.J: L. Erlbaum Associates.

Colwell, K., Hiscock-Anisman, C., Memon, A., Woods, D., & Michlik, P. M. (2006). Strategies of impression management among deceivers and truth-tellers: How liars attempt to convince. *American Journal of Forensic Psychology, 24,* 31–38.

Colwell, K., Memon, A., James-Kangal, N., Cole, L., Martin, M., Wirsing, E., & Cooper, B. (2018). Innocent suspects lying by omission. *Journal of Forensic Psychology, 3,* 1–6. doi: 10.4172/2475-319X.1000133

Comadena, M. E. (1982). Accuracy in detecting deception: Intimate and friendship relationships. In M. Burgoon (Ed.), *Communication yearbook 6* (pp. 446-472). Beverly Hills, CA: Sage.

Craig, D. R. (2003). The right to silence and undercover police operations. *International Journal of Police Science & Management, 5,* 112–125. doi:10.1350/ijps.5.2.112.14322

Deeb, H., Vrij, A., Hope, L., Mann, S., Granhag, P. A., & Lancaster, G. L. J. (2017). Suspects' consistency in statements concerning two events when different question formats are used. *Journal of Investigative Psychology and Offender Profiling*, *14*, 74–87. doi:10.1002/jip.1464

Deeb, H., Vrij, A., Hope, L., Mann, S., Granhag, P. A., & Strömwall, L. A. (2018). Police officers' perceptions of statement inconsistency. *Criminal Justice and Behavior, 45,* 644-665. doi:10.1177/0093854818758808

DePaulo, B. M. (1992). Nonverbal behavior and self-presentation. *Psychological Bulletin, 111,* 203–243. doi:10.1037/0033-2909.111.2.203

DePaulo, B. M., & Kashy, D. A. (1998). Everyday lies in close and casual relationships. *Journal of Personality and Social Psychology, 74,* 63–79. doi:10.1037/0022-3514.74.1.63

DePaulo, B. M., Kashy, D. A., Kirkendol, S. E., Wyer, M. M., & Epstein, J. A. (1996). Lying in everyday life. *Journal of Personality and Social Psychology, 70,* 979–995. doi:10.1037//0022-3514.70.5.979

DePaulo, B. M., Lindsay, J. J., Malone, B. E., Muhlenbruck, L., Charlton, K., & Cooper, H. (2003). Cues to deception. *Psychological Bulletin, 129,* 74–112. doi:10.1037//0033-2909.129.1.74

DePaulo, B. M., & Rosenthal, R. (1979). Telling lies. *Journal of Personality and Social Psychology, 37,* 1713–1722. doi: 10.1037/0022-3514.37.10.1713

Dunn, O. J. (1964). Multiple comparisons using rank sums. *Technometrics, 6,* 241-252. doi:10.1080/00401706.1964.10490181

Ekman, P., & Friesen, W. V. (1974). Detecting deception from the body or face. *Journal of Personality and Social Psychology, 29,* 288–298.

Elntib, S., Wagstaff, G. F., & Wheatcroft, J. M. (2015). The role of account length in detecting deception in written and orally produced autobiographical accounts using reality monitoring. *Journal of Investigative Psychology and Offender Profiling, 12,* 185–198. doi:10.1002/jip.1420

Ericsson, K. A., & Simon, H. A. (1980). Verbal reports as data. *Psychological Review, 87,* 215–251. doi: 10.1037/0033-295X.87.3.215

Ewens, S., Vrij, A., Jang, M., & Jo, E. (2014). Drop the small talk when establishing baseline behaviour in interviews. *Journal of Investigative Psychology and Offender Profiling, 11,* 244–252. doi:10.1002/jip.1414

Feeley, T. H., deTurck, M. A., & Young, M. J. (1995). Baseline familiarity in lie detection. *Communication Research Reports, 12,* 160–169. doi:10.1080/08824099509362052

Feitosa, J., Joseph, D. L., & Newman, D. A. (2015). Crowdsourcing and personality measurement equivalence: A warning about countries whose primary language is not English. *Personality and Individual Differences, 75,* 47–52. doi:10.1016/j.paid.2014.11.017

Feldman, R. S., Forrest, J. A., & Happ, B. R. (2002). Self-presentation and verbal deception: Do self-presenters lie more? *Basic and Applied Social Psychology, 24,* 163–170. doi:10.1207/153248302753674848

Fisher, R. J. (1993). Social desirability bias and the validity of indirect questioning. *Journal of Consumer Research, 20,* 303–315. doi:10.1086/209351

Fisher, A. J., Medaglia, J. D., & Jeronimus, B. F. (2018). Lack of group-to-individual generalizability is a threat to human subjects research. *Proceedings of the National Academy of Sciences of the United States of America, 115,* E6106–E6115. doi:10.1073/pnas.1711978115

Fiske, S. T., & Taylor, S. E. (2008). Social cognition: From brains to culture. Boston: McGraw-Hill.

Frank, M. G., Yarbrough, J. D., & Ekman, P. (2006). Investigative interviewing and the detection of deception. In T. Williamson (Ed.), *Investigative interviewing: Rights, research and regulation* (pp. 229–255). Devon, United Kingdom: Willan Publishing.

Funder, D. C., & Ozer, D. J. (2019). Evaluating effect size in psychological research: Sense and nonsense. *Advances in Methods and Practices in Psychological Science*. doi:10.1177/2515245919847202

George, J. F., & Robb, A. (2008). Deception and computer-mediated communication in daily life. *Communication Reports, 21*, 92–103. doi:10.1080/08934210802298108

Granhag, P. A., Clemens, F., & Strömwall, L. A. (2009). The usual and the unusual suspects: Level of suspicion and counter-interrogation tactics. *Journal of Investigative Psychology and Offender Profiling*, 6, 129–137. doi: 10.1002/jip.101

Granhag, P. A., & Hartwig, M. (2008). A new theoretical perspective on deception detection: On the psychology of instrumental mind-reading. *Psychology, Crime & Law, 14*, 189–200. doi:10.1080/10683160701645181

Granhag, P. A., & Strömwall, L. A. (2002). Repeated interrogations: Verbal and non-verbal cues to deception. *Applied Cognitive Psychology, 16*, 243-257. doi:10.1002/acp.784

Granhag, P. A., Strömwall, L. A., & Jonsson, A. C. (2003). Partners in crime: How liars in collusion betray themselves. *Journal of Applied Social Psychology, 33*, 848–868. doi:10.1111/j.1559-1816.2003.tb01928.x

Gnisci, A., Caso, L., & Vrij, A. (2010). Have you made up your story? The effect of suspicion and liars' strategies on reality monitoring. *Applied Cognitive Psychology, 24,* 762–773. doi:10.1002acp.1584

Hafer, C.L., & Bègue, L. (2005). Experimental research on just world theory: Problems, developments, and future challenges. *Psychological Bulletin, 131,* 128–167. doi:10.1037/0033-2909.131.1.128

Halevy, R., Shalvi, S., & Verschuere, B. (2014). Being honest about dishonesty: Correlating self-reports and actual lying. *Human Communication Research, 40,* 54–72. doi:10.1111/hcre.12019

Hartwig, M., & Bond, C. F. (2011). Why do lie-catchers fail? A lens model meta-analysis of human lie judgments. *Psychological Bulletin*, 137, 643–659. doi:10.1037/a0023589

Hartwig, M., Granhag, P. A., & Strömwall, L. A. (2007). Guilty and innocent suspects' strategies during police interviews. *Psychology, Crime and Law, 13,* 213–227. doi:10.1080/10683160600750264

Hartwig, M., Granhag, P. A., Strömwall, L. A., & Doering, N. (2010). Impression and information management: On the strategic self-regulation of innocent and guilty suspects. The Open Criminology Journal, 3, 10–16. doi:10.2174/1874917801003010010.

Hartwig, M., Granhag, P.A., Strömwall, L.A., & Vrij, A. 2004. Police Officers' Lie Detection Accuracy: Interrogating Freely versus Observing Video. *Police Quarterly*, 7, 429–456. doi:10.1177/1098611104264748

Harvey, A. C., Vrij, A., Nahari, G., & Ludwig, K. (2016). Applying the verifiability approach to insurance claims settings: Exploring the effect of the information protocol. *Legal and Criminological Psychology, 22,* 47–59. doi: 10.1111/lcrp.12092

Hayano, D. M. (1980). Communicative competency among poker players. *Journal of Communication, 30,* 113–120.

Inbau, F. E., Reid, J. E., Buckley, J. P., & Jayne, B. C. (2013). *Criminal interrogation and confessions* (5th ed.). Burlington, MA: Jones & Bartlett Learning.

Jarosz, A. F., & Wiley, J. (2014). What are the odds? A practical guide to computing and reporting Bayes factors. *The Journal of Problem Solving, 7,* 2–9. doi:10.7771/1932-6246.1167

Jeffreys, H. (1961). Theory of probability. Oxford, UK: Oxford University Press.

Johnson, M. K. (2006). Memory and reality. *American Psychologist, 61,* 760–771.

Johnson, M. K., & Raye, C. L. (1981). Reality monitoring. *Psychological Review, 88,* 67–85. doi: 10.1037/0033-295X.88.1.67

Johnson, M. K., Bush, J. G., & Mitchell, K. J. (1998). Interpersonal reality monitoring: Judging the sources of other people's memories. *Social Cognition, 16,* 199–224. doi:10.1521/ soco.1998.16.2.199

Jundi, S., Vrij, A., Hope, L., Mann, S., & Hillman, J. (2013). Establishing evidence through undercover and collective intelligence interviewing. *Psychology, Public Policy, & Law, 19*, 297–306. doi: 10.1037/a0033571

Kanwisher, N. (2009). "The use of fMRI in lie detection: what has been shown and what has not," in *Using Imaging to Identify Deceit: Scientific and Ethical Questions,* eds E. Bizzi, S. E. Hyman, M. E. Raichle, N. Kanwisher, E. A. Phelps, S. J. Morse et al. (Cambridge, MA: American Academy of Arts and Sciences), 7–13.

Koo, T. K., & Li, M. Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine, 15,* 155–163. doi:10.1016/j.jcm.2016.02.012

Landers, R. N., & Behrend, T. S. (2015). An inconvenient truth: Arbitrary distinctions between organizational, mechanical turk, and other convenience samples. *Industrial and Organizational Psychology, 8*, 142–164. doi:10.1017/iop.2015.13

Lane, L. W., Groisman, M., & Ferreira, V. S. (2006). Don't talk about pink elephants! speakers' control over leaking private information during language production. *Psychological Science, 17,* 273–277. doi:10.1111/j.1467-9280.2006.01697.x

Law, M. K. H., Jackson, S. A., Aidman, E., Geiger, M., Olderbak, S., & Kleitman, S. (2018). It's the deceiver, not the receiver: No individual differences when detecting deception in a foreign and a native language. *PloS One, 13,* e0196384. doi:10.1371/journal.pone.0196384

Leal, S., Vrij, A., Deeb, H., & Jupe, L. (2018). Using the model statement to elicit verbal differences between truth tellers and liars: the benefit of examining core and peripheral details. *Journal of Applied Memory and Cognition, 492.* doi: 10.1016/j.jarmac.2018.07.001

Leal, S., Vrij, A., Nahari, G., & Mann, S. (2016). Please be honest and provide evidence: Deterrents of deception in an online insurance fraud context. *Applied Cognitive Psychology*, *30*, 768–774. doi:10.1002/acp.3252

Lee, M. D., & Wagenmakers, E. J. (2013). *Bayesian cognitive modeling: A practical course*. Cambridge, New York: Cambridge University Press.

Leins, D., Fisher, R. P., & Ross, S. J. (2013). Exploring liars' strategies for creating deceptive reports. *Legal and Criminological Psychology, 18,* 141–151. doi:10.1111/j.2044-8333.2011.02041.x

Leins, D. A., Fisher, R. P., & Vrij, A. (2012). Drawing on liars' lack of cognitive flexibility: Detecting deception through varying report modes. *Applied Cognitive Psychology, 26,* 601-607. doi:10.1002/acp.2837

Leins, D., Fisher, R. P., Vrij, A., Leal, S., & Mann, S. (2011). Using sketch drawing to induce inconsistency in liars. *Legal and Criminological Psychology, 16,* 253–265.

Leins, D. A., Zimmerman, L. A., & Polander, E. N. (2017). Observers' real-time sensitivity to deception in naturalistic interviews. *Journal of Police and Criminal Psychology, 32,* 319–330. doi:10.1007/s11896-017-9224-2

Levine, T. R. (2010). A few transparent liars explaining 54% accuracy in deception detection experiments. *Annals of the International Communication Association, 34,* 41–61. doi:10.1080/23808985 .2010.11679095

Levine, T. R. (2016). Examining sender and judge variability in honesty assessments and deception detection accuracy: Evidence for a transparent liar but no evidence of deception-general ability. *Communication Research Reports, 33, 1*88–194. doi:10.1080/08824096.2016.1186629

Levine, T. R., Serota, K. B., Shulman, H., Clare, D. D., Park, H. S., Shaw, A. S., . . . Lee, J. H. (2011). Sender demeanor: Individual differences in sender believability have a powerful impact on deception detection judgments. *Human Communication Research, 37,* 377–403. doi:10.1111/j.1468-2958.2011.01407.x

Luke, T. J. (2019). Lessons from pinocchio: Cues to deception may be highly exaggerated. *Perspectives on Psychological Science, 14,* 646–671. doi:10.1177/1745691619838258

Luke, T. J., Hartwig, M., Joseph, E., Brimbal, L., Chan, G., Dawson, E., . . . Granhag, P. A. (2016). Training in the strategic use of evidence technique: Improving deception detection accuracy of American law enforcement officers. *Journal of Police and Criminal Psychology, 31,* 270–278. doi:10.1007/s11896-015-9187-0

Mann, S., Vrij, A., & Bull, R. (2004). Detecting true lies: Police officers' ability to detect suspects' lies. *Journal of Applied Psychology, 89,* 137–149. doi:10.1037/0021-9010.89.1.137

Masip, J., & Herrero, C. (2013). ‘What would you say if you were guilty?’ Suspects' strategies during a hypothetical behavior analysis interview concerning a

serious crime. *Applied Cognitive Psychology*, 27, 60–70. doi: 10.1002/acp.2872

Masip, J., Sporer, S. L., Garrido, E., & Herrero, C. (2005). The detection of deception with the reality monitoring approach: A review of the empirical evidence. *Psychology, Crime & Law*, *11*, 99–122. doi: 10.1080/10683160410001726356

McCornack, S. A., Morrison, K., Paik, J. E., Wisner, A. M., & Zhu, X. (2014). Information manipulation theory 2: A propositional theory of deceptive discourse production. *Journal of Language and Social Psychology, 33,* 348–377. doi:10.1177/0261927X14534656

McComack, S. A., & Parks, M. R. (1986). Deception detection and relational development: The other side of trust. In M. L. McLaughlin (Ed.), *Communication yearbook 9* (pp. 377-389). Beverly Hills, CA: Sage.

Meade, A. W., & Craig, S. B. (2012). Identifying careless responses in survey data. *Psychological Methods, 17,* 437–455. doi:10.1037/a0028085

Meissner, C. A., & Kassin, S. M. (2002). "He's guilty!" Investigator bias in judgments of truth and deception. *Law and Human Behavior, 26,* 469–480. doi: 10.1023/A:1020278620751

Meixner, J. B., & Rosenfeld, J. P. (2014). Detecting knowledge of incidentally acquired, real-world memories using a P300-based concealed-information test. *Psychological science, 25,* 1994–2005. doi: 10.1177/0956797614547278

Merckelbach, H. (2004). Telling a good story: fantasy proneness and the quality of fabricated memories. *Personality and Individual Differences, 37,* 1371–1382. doi: 10.1016/j.paid.2004.01.007 54

Mohamed, F. B., Faro, S. H., Gordon, N. J., Platek, S. M., Ahmad, H., & Williams, J. M. (2006). Brain mapping of deception and truth telling about an ecologically

valid situation: Functional MR imaging and polygraph investigation-initial experience. *Radiology, 238,* 679.

Münsterberg, H. (1908). *On the witness stand: Essays on psychology and crime.* New York: The McClure Company.

Nahari, G. (2016). When the long road is the shortcut: A comparison between two coding methods for content-based lie detection tools. *Psychology, Crime and Law, 22,* 1000–1014.

Nahari, G. (2018a). Reality monitoring in the forensic context: Digging deeper into the speech of liars. *Journal of Applied Research in Memory and Cognition, 7,* 432–440. doi:10.1016/j.jarmac.2018.04.003

Nahari, G. (2018b). The applicability of the verifiability approach to the real world. In P. Rosenfeld (Ed.), *Detecting concealed information and deception: Verbal, behavioral, and biological methods* (pp. 329–350). San Diego, CA: Academic Press. doi: 10.1016/B978-0-12- 812729-2.00014-8

Nahari, G. & Pazuelo, M. (2015). Telling a convincing story: richness in detail as a function of gender and priming. *Journal of Applied Research in Memory and Cognition, 4,* 363–367. doi: 10.1016/j.jarmac.2015.08.005 55

Nahari, G. & Vrij, A. (2015). Systematic errors (biases) in applying verbal lie detection tools: Richness in detail as a test case. *Crime Psychology Review, 1,* 98–107. doi:10.1080/23744006.2016.1158509

Nahari, G., Vrij, A., & Fisher, R. P. (2012). Does the truth come out in the writing? SCAN as a lie detection tool. *Law and Human Behavior, 36,* 68–76. doi:10.1037/h0093965

Nahari, G., Vrij, A., & Fisher, R. P. (2014a). Exploiting liar's verbal strategies by examining the verifiability of details. *Legal and Criminological Psychology, 19,* 227–239. doi:10.1111/j.2044-8333.2012.02069.x

Nahari, G., Vrij, A., & Fisher, R. P. (2014b). The verifiability approach: Countermeasures facilitate its ability to discriminate between truths and lies, countermeasures facilitate its ability to discriminate between truths and lies. *Applied Cognitive Psychology, 28,* 122e128. doi: 10.1002/acp.2974

Oberlader, V. A., Naefgen, C., Koppehele-Gossel, J., Quinten, L., Banse, R., & Schmidt, A. F. (2016). Validity of content-based techniques to distinguish true and fabricated statements: A meta-analysis. *Law and Human Behavior, 40,* 440–457. doi:10.1037/lhb0000193

Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science, 349,* aac4716.

Palena, N., Caso, L., & Vrij, A. (2019). Detecting lies via a theme-selection strategy. *Frontiers in Psychology, 9*. doi: 10.3389/fpsyg.2018.02775

Palena, N., Caso, L., Vrij, A., & Orthey, R. (2018). Detecting deception through small talk and comparable truth baselines. *Journal of Investigative Psychology and Offender Profiling, 15*. 124–132. doi: 10.1002/jip.1495

Porter, S., & Yuille, J. C. (1996). The language of deceit: An investigation of the verbal clues to deception in the interrogation context. *Law and Human Behavior, 20,* 443-458. doi:10.1007/BF01498980

Richard, F. D., Bond, C. F., & Stokes-Zoota, J. J. (2003). One hundred years of social psychology quantitatively described. *Review of General Psychology, 7,* 331-363. doi:10.1037/1089-2680.7.4.331

Riggio, R. E., Tucker, J., and Throckmorton, B. (1987). Social skills and deception ability. *Journal of Personality and Social Psychology, 13,* 568–577. doi: 10.1177/0146167287134013

Ruby, C. L., & Brigham, J. C. (1998). Can Criteria-Based Content Analysis distinguish between true and false statements of African-American speakers? *Law and Human Behavior*, 22, 369–388. doi: 10.1023/a:1025766825429

Russano, M. B., Narchet, F. M., Kleinman, S. M., & Meissner, C. A. (2014). Structured interviews of experienced HUMINT interviewers. *Applied Cognitive Psychology, 28*, 847–859. doi: 10.1002/acp.3069

Schank, R. C., & Abelson, R. P. (1977). *Scripts, plans, goals, and understanding: An inquiry into human knowledge structures*. New York; Hillsdale, N.J: L. Erlbaum Associates.

Schooler, J. (2011). Unpublished results hide the decline effect. *Nature, 470,* 437. doi: 10.1038/470437a

Serota, K. B., & Levine, T. R. (2015). A few prolific liars: Variation in the prevalence of lying. *Journal of Language and Social Psychology, 34,* 138–157. doi:10.1177/0261927X14528804

Serota, K. B., Levine, T. R., & Boster, F. J. (2010). The prevalence of lying in America: Three studies of self-reported lies. *Human Communication Research, 36*, 2–25. doi:10.1111/j.1468-2958.2009.01366.x

Sporer, S. L. (2016). Deception and cognitive load: Expanding our horizon with a working memory model. *Frontiers in Psychology*, 7, 420. doi: 10.3389/fpsyg.2016.00420

Sporer, S. L. and Küpper, B. (1995). Realitätsüberwachung und die Beurteilung des Wahrheitsgehaltes von Erzählungen: Eine experimentelle Studie [Reality monitoring and the judgment of credibility of stories: an experimental study]. *Zeitschrift fur Sozialpsychologie, 26,* 173–193.

Sporer, S. L., & Sharman, S. J. (2006). Should I believe this? Reality monitoring of accounts of self-experienced and invented recent and distant autobiographical events. *Applied Cognitive Psychology, 20,* 837–854. doi: 10.1002/acp.1234

Street, C. N. H., & Richardson, D. C. (2015). Lies, damn lies, and expectations: How base rates inform Lie–Truth judgments. *Applied Cognitive Psychology, 29,* 149–155. doi:10.1002/acp.3085

Steller, M., & Köhnken, G. (1989). Criteria-based content analysis. In Raskin, D. C. (Ed.), *Psychological methods in criminal investigation and evidence* (pp. 217–245). New York: Springer Publishing Company.

Strömwall, L. A., Hartwig, M., & Granhag, P. A. (2006). To act truthfully: Nonverbal behavior and strategies during a police interrogation. *Psychology, Crime & Law, 12,* 207–219. doi: 10.1080/10683160512331331328

Strömwall, L., & Granhag, P. A. (2003). How to detect deception? Arresting the beliefs of police officers, prosecutors and judges. *Psychology, Crime & Law, 9,* 19–36. doi:10.1080/10683160308138

Strömwall, L. A., Granhag, P. A., & Hartwig, M. (2004). Practicioners' beliefs about deception. In L. A. Strömwall & P. A. Granhag (Eds.), *The detection of deception in forensic contexts*. (pp. 229–250). Cambridge, England: Cambridge University Press.

Strömwall, L. A., Willén, R. M. (2011). Inside criminal minds: Offenders' strategies when lying. *Journal of Investigative Psychology and Offender Profiling, 8*, 271–281. doi:10.1002/jip.148

Thalheimer, W., & Cook, S. (2002, August). How to calculate effect sizes from published research articles: A simplified methodology. Retrieved May 22, 2019 from http://www.bwgriffin.com/gsu/courses/edur9131/content/Effect_Sizes_pdf5.pdf.

Undeutsch, U. (1967). Beurteilung der glaubhaftigkeit von aussagen [Evaluation of statement credibility/ Statement validity assessment]. In U. Undeutsch (Ed.), *Hand-buch der Psychologie* (Vol. 11: Forensische Psychologie, pp. 26-181). Göttingen, Germany: Hogrefe.

Undeutsch, U. (1989). The development of statement reality analysis. In J. Yuille (Ed.), *Credibility assessment* (pp.101-119). Dordrech, Holland: Kluwer Academic Publishers.

U.S. Department of the Army (2006). Field manual 2–22.3 (FM 34–52) Human intelligence collector operations. Washington, DC: Headquarters, Department of the Army.

Valois, R., Akehurst, L., Hanway, P., & Williams, R. (2019). Half truths and whole lies: Credibility judgements of partial and complete fabrications using Criteria-Based Content Analysis and Reality Monitoring. Manuscript submitted for publication.

Bogaard, G., Meijer, E. H., & Van der Plas, I. (2019). A model statement does not enhance the verifiability approach. *Applied Cognitive Psychology*. doi:10.1002/acp.3596

Van Swol, L. M., & Braun, M. T. (2014). Communicating deception: Differences in language use, justifications, and questions for lies, omissions, and truths. *Group Decision and Negotiation, 23,* 1343–1367. doi:10.1007/s10726-013-9373-3

Van Swol, L. M., Braun, M. T., & Kolb, M. R. (2015). Deception, detection, demeanor, and truth bias in face-to-face and computer-mediated communication. *Communication Research, 42,* 1116–1142. doi:10.1177/0093650213485785

Verigin, B. L., Meijer, E. H., Vrij, A., & Zauzig, L. (2019). The interaction of truthful and deceptive information. *Psychology, Crime & Law.* doi: 10.1080/1068316X.2019.1669596

Verschuere, B., Vrij, A., & Granhag, P. A. (2015). *Detecting deception: Current challenges and cognitive approaches*. Hoboken: Wiley-Blackwell.

Volbert, R., & Steller, M. (2014). Is this testimony truthful, fabricated, or based on false memory? Credibility assessment 25 years after Steller and Köhnken (1989). *European Psychologist*, 19, 207–220. doi: 10.1027/1016-9040/a000200

Vredeveldt A., van Koppen P., Granhag P.A. (2014). The Inconsistent Suspect: A Systematic Review of Different Types of Consistency in Truth Tellers and Liars. In: Bull R. (eds) *Investigative Interviewing* (pp. 189–207). Springer, New York, NY.

Vrij, A. (2005). Criteria-based content analysis: A qualitative review of the first 37 studies. *Psychology, Public Policy, and Law, 11,* 3–41. https:// doi.org/10.1037/1076-8971.11.1.3

Vrij, A. (2007). Deception: a social lubricant and a selfish act. In K. Fiedler (Ed.), *Social communication* (pp. 309–342). (Frontiers of social psychology). New York: Psychology Press.

Vrij, A. (2008a). Detecting lies and deceit: Pitfalls and opportunities, second edition. Chichester: John Wiley and Sons.

Vrij, A. (2008b). Nonverbal dominance versus verbal accuracy in lie detection: A plea to change police practice. *Criminal Justice and Behavior, 35,* 1323–1336. doi:10.1177/0093854808321530

Vrij, A. (2016). Baselining as a lie detection method. *Applied Cognitive Psychology, 30,* 1112-1119. doi:10.1002/acp.3288

Vrij, A. (2018). Deception and truth detection when analyzing nonverbal and verbal cues. *Applied Cognitive Psychology,* 1–8. doi:10.1002/acp.3457

Vrij, A., Akehurst, L., Soukara, S., & Bull. R. (2002). Will the truth come out? The effect of deception, age, status, coaching, and social skills on CBCA scores. *Law and Human Behaviour, 26,* 261–283. doi: 10.1023/A:1015313120905

Vrij, A., Edward, K., Roberts, K. P., & Bull, R. (2000). Detecting deceit via analysis of verbal and nonverbal behavior. *Journal of Nonverbal Behavior, 24,* 239–263. doi:10.1023/A:1006610329284

Vrij, A., Fisher, R. P., & Blank, H. (2017). A cognitive approach to lie detection: A meta-analysis. *Legal and Criminological Psychology, 22,* 1–21. doi:10.1111/lcrp.12088

Vrij, A., Granhag, P. A., & Mann, S. (2010). Good liars. *The Journal of Psychiatry & Law, 38,* 77–98. doi:10.1177/009318531003800105

Vrij, A., Granhag, P. A., Mann, S., & Leal, S. (2011). Outsmarting the liars: Toward a cognitive lie detection approach. *Current Directions in Psychological Science, 20*, 28–32. doi:10.1177/0963721410391245

Vrij, A., Granhag, P. A., & Porter, S. (2010). Pitfalls and opportunities in verbal and nonverbal lie detection. *Psychological Science in the Public Interest, 11*, 89–121. doi: 10.1177/1529100610390861

Vrij, A., Leal, S., & Fisher, R. P. (2018). Verbal deception and the model statement as a lie detection tool. *Frontiers in Psychiatry, 9*, 492–492. doi:10.3389/fpsyt.2018.00492

Vrij, A., Leal, S., Fisher, R. P., Mann, S., Dalton, G., Jo, E., … Houston, K. (2018). Sketching as a technique to elicit information and cues to deceit in interpreter-based interviews. *Journal of Applied Research in Memory and Cognition, 7,* 303–313. doi: 10.1016/j. jrarmac.2017.11.001

Vrij, A., Leal, S., Jupe, L., & Harvey, A. (2018). Within-subjects verbal lie detection measures: A comparison between total detail and proportion of complications. *Legal and Criminological Psychology, 23,* 265–279. doi:10.1111/lcrp.12126

Vrij, A., Leal, S., Mann, S., Dalton, G., Jo, E., Shaboltas, A., … Houston, K. (2017). Using the model statement to elicit information and cues to deceit in interpreter-based interviews. *Acta Psychologica, 177,* 44–53. doi: 10.1016/j.actpsy.2017.04.011

Vrij, A., Leal, S., Mann, S., & Fisher, R. (2012). Imposing cognitive load to elicit cues to deceit: Inducing the reverse order technique naturally. *Psychology, Crime & Law, 18,* 579–594. DOI:10.1080/ 1068316X2010.515987

Vrij, A., Leal, S., Mann, S., Fisher, R. P., Dalton, G., Jo, E., ... Houston, K. (2018). Using unexpected questions to elicit information and cues to deceit in

interpreter-based interviews. *Applied Cognitive Psychology*, *32*, 94–104. doi: 10.1002/acp.3382

Vrij, A., & Mann, S. (2001). Telling and detecting lies in a high-stake situation: The case of a convicted murderer. *Applied Cognitive Psychology*, *15*, 187–203. doi:10.1002/1099-0720(200103/04)15:2<187::AID-ACP696>3.0.CO;2-A

Vrij, A., Mann, S., Jundi, S., Hillman, J. & Hope, L. (2014). Detection of concealment in an information-gathering interview. *Applied Cognitive Psychology*, *28*, 86–866. doi: 10.1002/acp.305

Wagenmakers, E. J., Love, J., Marsman, M., Jamil, T., Ly, A., Verhagen, J., . . . Morey, R. D. (2016). Bayesian inference for psychology. Part II: Example applications with JASP, 1-26. Retrieved from http://maartenmarsman.com/wpcontent/uploads/2017/04/WagenmakersEtAlPartII.pdf

Walczyk, J. J., Harris, L. L., Duck, T. K., & Mulay, D. (2014). A social-cognitive framework for understanding serious lies: Activation-decision-construction-action theory. *New Ideas in Psychology, 34*, 22–36. doi:10.1016/j.newideapsych.2014.03.001

Whitty, M. T., & Carville, S. E. (2008). Would I lie to you? Self-serving lies and other oriented lies told across different media. *Computers in Human Behavior, 24*, 1021–1031. doi: 10.1016/j. chb.2007.03.004

Wright, G. R. T., Berry, C. J., & Bird, G. (2012). "You can't kid a kidder": Association between production and detection of deception in an interactive deception task. *Frontiers in Human Neuroscience, 6,* 87. doi: 10.3389/fnhum.2012.00087

Wright, G. R. T., Berry, C. J., & Bird, G. (2013). Deceptively simple … the "deception-general" ability and the need to put the liar under the spotlight. *Frontiers in Neuroscience, 7,* 152. doi: 10.3389/fnins.2013.00152

Wright, C., & Wheatcroft, J. M. (2017). Police officers' beliefs about, and use of, cues to deception. *Journal of Investigative Psychology and Offender Profiling, 14, 307*–319. doi:10.1002/jip.1478

Zhou, L., Burgoon, J.K., Nunamaker, J.F., & Twitchell, D. (2004). Automatic linguistic-based cues for detecting deception in text-bases asynchronous computer-mediated communication. *Group Decision and Negotiation, 13,* 81–106. doi:10.1023/B:GRUP.0000011944.62889.6f

Appendices

List of Appendices

Appendix A: Supplementary materials (Chapter 2; Study I)

1. Questionnaire Definitions

1. Questionnaire Definitions

After providing informed consent, and prior to beginning the questionnaire, participants were provided the following set of definitions, which they were asked to read carefully and to keep in mind while making responses throughout the questionnaire: (1) "*To lie (i.e., deceive) is to successfully or unsuccessfully make a false statement (to another person), without forewarning, with the intention that the statement will be believed to be true (by the other person); misremembering is not the same as lying; a successful lie means that the intended false-belief has been produced, whereas an unsuccessful lie means that the intended false-belief has not been produced."* (2) *"Strategies for telling lies (i.e., strategies of deception) refer to the self-regulatory method/s that an individual may use to increase their chances of telling a successful lie."*

During the questionnaire, participants were asked to indicate how many lies, of several types, they had told within the past 24 hours. I described each of the options as follows: White lies (*Lies of this type occur when someone makes an inconsequential false statement with the purpose of easing social interactions*), Exaggerations (*Lies of this type occur when someone intentionally makes a statement that reports something as being better or worse than it really is*), Omissions/Concealment (*Lies of this type occur when someone intentionally withholds information, with the purpose of harming or disadvantaging the receiver for the liar's own benefit*), Commission/ Fabrications (*Lies of this type occur when false information is intentionally presented as if it was true, with the purpose of harming or disadvantaging the receiver for the liar's own benefit*), and Embedded lies (*Lies of this type occur when a statement contains one or more lies that are incorporated into an otherwise truthful story, for the liar's own benefit*).

As well, during the questionnaire participants were asked to rate on a 10-point Likert scale (1 – not important to 10 – very important) how important they consider verbal and nonverbal strategies of deception to be for getting away with a lie. I described verbal strategies as: "*Relating to the control of an individual's speech to say things that give a credible impression and avoid raising suspicion of possible deception"* and nonverbal strategies of deception as: *"Relating to the control of an individual's behaviour to display body language that gives a credible impression and avoids raising suspicion of possible deception".*

Appendix B: Supplementary materials (Chapter 3; Study II)

1. Instruction Letters One and Two by Condition
2. Structured Interview Question Format

1. Instruction Letters One and Two by Condition[11]

Instruction Letter One. The specific instructions participants received depended on their conditions, as follows:

Truth-Truth condition:

Dear Participant:

I. Please complete the following two tasks:

- **Task A:** Your assignment is to help develop a promotional flyer for __ located in __. Using the camera provided, please make your way to the __ and take photos that can be included on the flyer to promote the café. Please avoid taking photos of the customers. After doing so, please complete Task B.

- **Task B:** Your assignment is to go to the bus stop __ located at __ to search for Michelle (photo attached), who will be arriving by bus sometime today. Please use the paper and pen provided to write down the information for any buses that arrive and/or depart during your time. If you see Michelle arrive, please take a photo of her using the camera provided. Wait at the bus stop for a minimum of five minutes, and then return to the research room, regardless of whether you find Michelle or not.

II. Please report back to the experimenter in between **twenty to thirty-five minutes**. You will then receive your next instructions.

Lie-Lie condition:

Dear Participant:

I. For the next **twenty to thirty-five** minutes, please exit the research room and make yourself busy (e.g., study, get a coffee). Once that time is up, please return to the room and you will then receive your next instructions.

Truth-Lie condition:

Dear Participant:

I. Please complete the following task:

- Your assignment is to help develop a promotional flyer for __ located in __. Using the camera provided, please make your way to the __ and take photos that can be included on the flyer to promote the café. Please avoid taking photos of the customers.

II. Please report back to the experimenter in between **twenty to thirty-five** minutes. You will then receive your next instructions.

Lie-Truth condition:

Dear Participant:

I. Please complete the following task:

- Your assignment is to go to the bus stop __ located at __ to search for Michelle (photo attached), who will be arriving by bus sometime today. Please use the paper and pen provided to write down the information for any buses that arrive and/or depart during your time. If you see Michelle arrive, please take a photo of her using the camera provided. Wait at the bus stop for a minimum of five minutes, and then return to the research room, regardless of whether you find Michelle or not.

II. Please report back to the experimenter in between **twenty to thirty-five** minutes. You will then receive your next instructions.

[11] Information regarding specific locations has been removed to allow for a blinded review.

Instruction Letter Two.

Truth-Truth condition:

Dear Participant:

I. For the next phase of this experiment, you will be interviewed by the researcher about the tasks you have completed. Please report your memories truthfully and with as much detail as possible. Please report and answer questions based on having completed *both* of the following tasks:

- **Task A:** Your assignment is to help develop a promotional flyer for __ located in __. Using the camera provided, please make your way to the __ and take photos that can be included on the flyer to promote the café. Please avoid taking photos of the customers. After doing so, please complete Task B.

- **Task B:** Your assignment is to go to the bus stop __ located at __ to search for Michelle (photo attached), who will be arriving by bus sometime today. Please use the paper and pen provided to write down the information for any buses that arrive and/or depart during your time. If you see Michelle arrive, please take a photo of her using the camera provided. Wait at the bus stop for a minimum of five minutes, and then return to the research room, regardless of if you find Michelle or not.

II. Without using the photos or written document, you must convince the interviewer that you completed *both* Task A and Task B. If you are highly convincing and the interviewer does not suspect you are fabricating your reports, you will be entered into a raffle for the chance to win a 50€ VVV voucher. If you fail to convince the interviewer, you will be required to stay an additional twenty minutes to provide a written account of your statements.

You have **ten** minutes to prepare your statements. Please do not write any notes.

Lie-Lie condition:

Dear Participant:

I. For the next phase of this experiment, you will be interviewed by the researcher. Please report and answer questions with as much detail as possible, as if you had completed *both* of the following tasks:

- **Task A:** Your assignment is to help develop a promotional flyer for __ located in __. Using the camera provided, please make your way to __ and take photos that can be included on the flyer to promote the café. Please avoid taking photos of the customers.

- **Task B:** Your assignment is to go to the bus stop __ located at __ to search for Michelle (photo attached), who will be arriving by bus sometime today. Please use the paper and pen provided to write down the information for any buses that arrive and/or depart during your time. If you see Michelle arrive, please take a photo of her using the camera provided. Wait at the bus stop for a minimum of five minutes, and then return to the research room, regardless of if you find Michelle or not.

II. You must convince the interviewer that you completed *both* Task A and Task B. If you are highly convincing and the interviewer does not suspect you are fabricating your reports, you will be entered into a raffle for the chance to win a 50€ VVV voucher. If you fail to convince the interviewer, you will be required to stay an additional twenty minutes to provide a written account of your activities over the past hour.

You have **ten** minutes to prepare your statement. Please do not write any notes.

Truth-Lie condition:

Dear Participant:

I. For the next phase of this experiment, you will be interviewed by the researcher about the task you completed. Please report your memories truthfully and with as much detail as possible. In addition to reporting about the task you did complete, you must also report that you completed Task B. Therefore, please report and answer questions as if you had completed *both* of the following tasks:

- **Task A:** Your assignment is to help develop a promotional flyer for __ located in __. Using the camera provided, please make your way to __ and take photos that can be included on the flyer to promote the café. Please avoid taking photos of the customers. After doing so, please complete Task B.

- **Task B:** Your assignment is to go to the bus stop __ located at __ to search for Michelle (photo attached), who will be arriving by bus sometime today. Please use the paper and pen provided to write down the information for any buses that arrive and/or depart during your time. If you see Michelle arrive, please take a photo of her using the camera provided. Wait at the bus stop for a minimum of five minutes, and then return to the research room, regardless of if you find Michelle or not.

II. Without using the photos or written document, you must convince the interviewer that you completed both Task A and Task B. If you are highly convincing and the interviewer does not suspect you are fabricating your reports, you will be entered into a raffle for the chance to win a 50€ VVV voucher. If you fail to convince the interviewer, you will be required to stay an additional twenty minutes to provide a written account of your statements.

You have **ten** minutes to prepare your statements. Please do not write any notes.

Lie-Truth condition:

Dear Participant:

I. For the next phase of this experiment, you will be interviewed by the researcher about the task you completed. Please report your memories truthfully and with as much detail as possible. In addition to reporting about the task you did complete, you must also report that you completed Task A. Therefore, please report and answer questions as if you had completed *both* of the following tasks:

- **Task A:** Your assignment is to help develop a promotional flyer for __ located in __. Using the camera provided, please make your way to __ and take photos that can be included on the flyer to promote the café. Please avoid taking photos of the customers.

- **Task B:** Your assignment is to go to the bus stop __ located at __ to search for Michelle (photo attached), who will be arriving by bus sometime today. Please use the paper and pen provided to write down the information for any buses that arrive and/or depart during your time. If you see Michelle arrive, please take a photo of her using the camera provided. Wait at the bus stop for a minimum of five minutes, and then return to the research room, regardless of if you find Michelle or not.

II. Without using the photos or written document, you must convince the interviewer that you completed both Task A and Task B. If you are highly convincing and the interviewer does not suspect you are fabricating your reports, you will be entered into a raffle for the chance to win a 50€ VVV voucher. If you fail to convince the interviewer, you will be required to stay an additional twenty minutes to provide a written account of your statements.

You have **ten** minutes to prepare your statements. Please do not write any notes.

2. Structured Interview Question Format

Structured Interview Format. Participants were interviewed according to the following format:

Structured Interview Format:
PART ONE: (Task A) I'll ask you to begin by providing a free recall of what you did for Task A and then I will ask you some specific questions.
1. In as much detail as possible, please walk me through exactly what you did from the moment you left this room to the moment you finished Task A.
2. What else can you tell me about this task?
3. How long did this task take you?
4. Did you find this task difficult?
5. Did anything unexpected happen or perhaps something that didn't go as planned?
6. Without showing me the camera or notes, please describe what I will see when I look at them.
PART TWO: (Task B) I'll now ask you to provide a free recall of what you did for Task B and then I will ask you some specific questions.
1. In as much detail as possible, please walk me through exactly what you did from the moment you finished Task B to the moment you walked back to this room.
2. What else can you tell me about this task?
3. How long did this task take you?
4. Did you find this task difficult?
5. Did anything unexpected happen or perhaps something that didn't go as planned?
7. Without showing me the camera or notes, please describe what I will see when I look at them.
PART THREE: (Task A and B) 1. Please think back over the entire assignment, and try to remember if there are any other details that you may have missed.

Appendix C: Supplementary materials (Chapter 4; Study III)

1. Instruction Letters to Participants
2. Structured Interview Format
3. Coding Description: Verbal Content Analysis

1. Instruction Letters to Participants[12]

Truth-Teller Condition:

Dear Participant,

I. Please imagine that you have been called into a police station as a suspect in a violent burglary that occurred on ____[*DATE*]____ between approximately 1-3pm. The police have reason to believe that you may have been involved, so they have requested that you provide an alibi statement for your whereabouts on this day.

II. You are ***innocent*** of the crime in question; therefore, your task is to convince the interviewer of your innocence by providing a truthful alibi. Read the following instructions carefully:

- *Think back to the day that you completed the following activity/activities:*

  _____*[ACTIVITY]*_____.
  Please report exactly what you did on this day (from morning to evening), being sure to include the activity/activities between 1-3pm.

III. During your interview, please provide a truthful statement and answer questions with as much detail as possible, including time stamps wherever possible. If you are highly convincing and the interviewer does not suspect you are lying, you will be entered into a raffle for the chance to win a 50£ voucher. If you fail to convince the interviewer, you will be required to stay an additional twenty minutes to provide a written account of your statement.

You have up to **ten** minutes to prepare your statement. Please do not write any notes.

[12] The blank spaces were filled in by the lead researcher based on the selected alibi activity and date.

Fabricated Liar Condition:

Dear Participant,

I. Please imagine that you have been called into a police station as a suspect in a violent burglary that occurred on ____[*DATE*]____ between approximately 1-3pm. The police have reason to believe that you may have been involved, so they have requested that you provide an alibi statement for your whereabouts on this day.

II. You are ***guilty*** of the crime in question, and your task is to try and convince the interviewer that you are innocent by providing a completely deceptive alibi.
Read the following instructions carefully:

- *Please do not report what you actually did on ____[DATE]____ ; rather,* ***make up a false statement to explain what you did that day (from morning to evening), including the deceptive story that you completed the following activity/activities from approximately 1-3pm:***

  [ACTIVITY] .

III. During your interview, please report and answer questions with as much detail as possible, including time stamps wherever possible. If you are highly convincing and the interviewer does not suspect you are lying, you will be entered into a raffle for the chance to win a 50£ voucher. If you fail to convince the interviewer, you will be required to stay an additional twenty minutes to provide a written account of your statement.

You have up to **ten** minutes to prepare your statement. Please do not write any notes.

Embedded Liar Condition:

Dear Participant,

I. Please imagine that you have been called into a police station as a suspect in a violent burglary that occurred on____[*DATE*]____ between approximately 1-3pm. The police have reason to believe that you may have been involved, so they have requested that you provide an alibi statement for your whereabouts on this day.

II. You are ***guilty*** of the crime in question, and your task is to try and convince the interviewer that you are innocent by providing a partially deceptive alibi.
Read the following instructions carefully:

- *Please truthfully report what you actually did on ____[DATE]____ (from morning to evening), and* ***you must also incorporate into this truthful statement the deceptive story that you completed the following activity/activities from approximately 1-3pm:*** *_____[ACTIVITY]_____.*

III. During your interview, please report and answer questions with as much detail as possible, including time stamps wherever possible. If you are highly convincing and the interviewer does not suspect you are lying, you will be entered into a raffle for the chance to win a 50£ voucher. If you fail to convince the interviewer, you will be required to stay an additional twenty minutes to provide a written account of your statement.

You have up to **ten** minutes to prepare your statement. Please do not write any notes.

2. Structured Interview Format

The interviewer began by stating that her goal was to obtain as much information as possible and to determine how credible the participant's alibi was. She instructed the participant to report as many details as possible, even if s/he did not think they were important. She advised the participant to include time stamps wherever possible.

Structured Interview Format:
1. In as much detail as possible, please walk me through everything that you did – from morning to evening – ____[*DATE*]____ .[13] 2. What else can you tell me about that day? 3. Being as detailed as possible, please tell me what you were doing from approximately 1 to 3pm. 4. On this day, did anything unexpected happen or perhaps something that didn't go as planned? 5. Please think back over the entire day, and try to remember if there are any other details that you may have forgotten or missed.

[13] The specific day that participants were questioned about was determined based on the event they had been matched to.

3. Coding Description: Verbal Content Analysis

Coding. ***Verbal content analysis*****.** The video recorded interviews were transcribed verbatim. The Principal Investigator who has expertise with verbal statement analysis extensively trained a second coder, who was blind to the experimental conditions, to assess statements for several cues. First, statements were assessed for the *richness of detail* by coding the presence of: i) spatial information: Information about locations (e.g., "At Wetherspoon pub") or the spatial arrangement of people and/or objects (e.g., "Sitting in the row behind my friend"); ii) temporal information: Information about when the activities or event happened (e.g., "It was 6:00pm"), duration of an activity (e.g., "We were in the restaurant for one hour"), or an explicit description of a sequence of events (e.g., "I started to do revision notes after I finished eating dinner"); and iii) perceptual information: Information about what the interviewee saw (e.g., "I saw him sitting at the bar"), smelled (e.g., "It smelled like my roommate had made coffee"), heard (e.g., "He ordered a glass of wine"), tasted (e.g., "The gelato was sweet), or felt (e.g., "The sunshine felt really warm") during their statement. The coding scheme was derived from the RM literature (Johnson & Raye, 1981) and similar schemes have been used in number of deception studies (e.g., Nahari, 2018a). The richness of detail score represents the sum total of the frequency of occurrences of spatial, temporal, and/or perceptual details.

Next, we coded for the *verifiability of detail* by examining statements for activities that met the following criteria: i) they were documented and therefore potentially checkable (e.g., receipt of purchase), ii) they were carried out together with (an) other identified person(s), rather than alone or with a stranger who could not easily be identified (e.g., study group meeting with specifically named individuals), iii) they pertained to something that was witnessed by (an) other identified person(s) (e.g.,

having your professor arrive late to an exam), iv) they were reported as being recorded by the interviewee (e.g., leaving a voicemail), v) they used technology (e.g., use of a phone or computer), or vi) they could potentially be checked by blood analysis and medical tests (e.g., drinking alcohol). The verifiability of detail score represents the sum total of the frequency of occurrence of all details that met one or more criteria to be considered verifiable. These criteria were drawn from the VA literature (Boskovic, Bogaard, Merckelbach, Vrij & Hope, 2017; Nahari et al., 2014a, 2014b). I did not include the information protocol, which is part of the complete VA procedure, because it was outside of the scope of the current study.

The overall *statement quality* was also assessed by evaluating i) the clarity and vividness of the statement on a 3-point Likert scale, where 0 is not at all clear and vivid; 1 is somewhat clear and vivid, and 2 is very clear and vivid. Evaluators were given the following prompt: "Do you have a clear, vivid idea of what the interviewee did that day or is it vague and dim?" The second component of statement quality was evaluated by ii) the plausibility of the statement, again measured on a 3-point Likert scale (i.e., 0 – not at all plausible, 1 – somewhat plausible, and 2 – very plausible). Evaluators were told to consider the following: "Does the interviewees' statement make plausible, realistic sense and follow a logical structure or is it unrealistic and non-logical?" The statement quality variable represents the combined total of both the clarity and plausibility scores. Both of these cues relate to the RM literature and have been examined in a number of other studies (e.g., DePaulo et al., 2003; Johnson & Raye, 1981; Leal et al., 2015; Sporer & Küpper, 1995; Zhou et al., 2004).

Statements were assessed for the presence of *complications*, or rather, occurrences (caused by the interviewee, a third person, or another situational factor) that make a situation more difficult than necessary, often characterised by disrupted

activity, failing efforts, failures to progress and activity, suddenly appearing people and/or obstacles, etcetera (e.g., missing the bus or making an unplanned detour during a trip). This cue was originally based on CBCA literature (Steller & Köhnken, 1989), but the more comprehensive definition was derived from Vrij, Leal, Jupe, & Harvey (2018). Evaluators also coded for *common knowledge details*, which are statements that strongly invoke common stereotypical knowledge about everyday events with an absence of personalised, experienced, or unique information (e.g., "We went to pick up food at the store"), and *self-handicapping strategies*, relating to the presence of explicit or implicit justifications made by the interviewee for why they cannot provide certain information (e.g., "My friend chose the restaurant, so I can't remember the name"). In line with previous research (e.g., Vrij, Leal, Jupe et al., 2018), I calculated the proportion of complications by computing a total score (number of complications + number of common knowledge details + number of self-handicapping strategies) and dividing the number of complications by this total score. Scores above .50 specify that the participants reported more complications than the sum total of common knowledge details and self-handicapping strategies, while scores below .50 indicate that the participants reported more common knowledge details and self-handicapping strategies (when summed) than complications. The coding scheme for these criteria was modelled after the work of Vrij, Leal, Mann, et al., 2017 in particular (cf. Sporer, 2016; Volbert & Steller, 2014; Vrij, Leal, Jupe et al., 2018).

Appendix D: Supplementary materials (Chapter 5; Study IV)

1. Experimental Instructions
2. Cues to Veracity

1. Experimental Instructions

Please imagine yourself in the role of a district detective in the Criminal Investigation Department of the Limburg Police. You are the lead detective for an investigation into a violent burglary that occurred approximately one week ago. Your colleague just finished interviewing a suspect, and your job is to review the interview statement and to assess the suspect's credibility. The interviewee has provided an alibi statement for the entire day in question, from morning to evening, but the critical period of time (i.e., the "statement of interest") that you are most interested in is from ***1:00pm to 3:00pm****. Your task is to read the statement carefully and to make a decision about the truthfulness of the critical statement of interest (i.e., the highlighted information, the period of time from 1:00pm to 3:00pm). You will then respond to several questions regarding your decision.*

It is extremely important that your decision is correct, if not, either the perpetrator gets away with the crime OR you may send an innocent person to jail. Plus, if you make the correct decisions regarding truthfulness, you will be entered into a raffle to win €50 …

Additional instruction for Baseline-present condition:

As the lead investigator, you have access to other sources of information for this case. This evidence confirms that ***the "general" alibi statement before 1:00pm and after 3:00pm is truthful.*** Please use this knowledge to compare the "general" part of the interviewees' alibi to the "statement of interest from 1:00pm to 3:00pm)." Try to identify any patterns or changes in the verbal content between the general alibi and the statement of interest that may indicate how credible the suspect's story from 1:00pm to 3:00pm is.

2. Cues to Veracity

I also explored participants' self-reported cues to perceived deception (open-ended and multiple-response). Participants gave an open-ended description of the verbal cues used to form their veracity judgement, and finally, participants identified which verbal cues they used from set of listed content-based cues (e.g., the verifiability of details, consistency within the statement, etcetera).

Coding. A wide variety of responses were obtained in response to the question: *"What verbal cues did you use to decide whether the critical element of the interviewee's statement (1:00pm to 3:00pm) was truthful or deceptive?"* To condense these data, responses were assigned to specific verbal cues such as "Quantity of details", "Contradictions and inconsistencies", "Unexpected complications", or "Lack of conviction/memory". The complete list consisted of 41 cues and was derived from CBCA and RM literature as well as similar veracity-cue lists used by Bogaard and colleagues (2016, 2018), Vrij and colleagues (2006) and Akehurst and colleagues (1996). This coding scheme contained cues only regarding the content qualities of the statement and the speech characteristics that were identifiable in a written transcript. Additionally, a selection of data-driven verbal cues were included (e.g., "Differences between the baseline and critical element in terms of the type, or amount, of detail"). All responses were categorised according to the cues listed in Supplementary Table 3.

To establish reliability, the Principal Investigator trained a Research Assistant, who was blind to the experimental conditions. Both individuals then coded all participants' open-ended responses for the presence of these cues. The agreement between raters was excellent (see Supplementary Table 1 for the exact values). After establishing reliability between the two raters, I considered only the cues that both raters were in agreement upon; therefore, I only coded a cue as present when both raters

agreed upon its presence, when raters disagreed upon its presence; the cue was scored as absent.

Supplementary Table 1

Reliability statistics for qualitative coding of verbal cues

Verbal Cue	Cohen's Kappa (κ)	Significance level (p)	Percentage Agreement
1. Coherence	1.00	< .0005	100
2. Clarity/vividness	1.00	< .0005	100
3. Spontaneous corrections	0.949	< .0005	99.33
4. Contradictions and inconsistency	0.899	< .0005	96.64
5. Perceptual information	1.00	< .0005	100
6. Emotions	1.00	< .0005	100
7. Quantity of details	0.909	< .0005	99.33
8. Spatial information	1.00	< .0005	100
9. Unstructured production	0.878	< .0005	97.99
10. Description of interaction	--	--	100
11. Temporal information	1.00	< .0005	100
12. Extraneous information	1.00	< .0005	100
13. Reproduction of conversation	-	-	99.33
14. Reconstructability of the statement	--	--	100
15. Unusual details	1.00	< .0005	100
16. Plausibility	0.902	< .0005	98.66
17. Cognitive operations	0.661	< .0005	98.66
18. Denial of allegation	--	--	100
19. Social introduction	1.00	< .0005	100
20. Lack of conviction or memory	0.956	< .0005	99.33
21. Main event of the statement	--	--	100
22. Objective versus subjective time	1.00	< .0005	100
23. Missing information	1.00	< .0005	100
24. First person singular, past tense	-	-	99.33
25. Use of pronouns	1.00	< .0005	100
26. Changes in language	0.832	< .0005	98.66
27. Length of the statement	--	--	100
28. Self-references	--	--	100
29. Grammatical errors/changes	1.00	< .0005	100
30. Repetitions	0.892	< .0005	99.33
31. Clichés	--	--	100
32. Evasive responses	1.00	< .0005	100
33. Unexpected complications	0.797	< .0005	99.33
34. Self-deprecation	--	--	100

35. NA/ nonsense response	0.854	< .0005	99.33
36. Filler words indicative of hesitations	0.954	< .0005	99.33
37. Providing un/verifiable details	0.938	< .0005	99.33
38. Differences between baseline and critical period: *Amount* of detail	0.893	< .0005	98.66
39. Differences between baseline and critical period: *Type* of details	0.878	< .0005	95.97
40. Specific details/wording /phrasing	0.793	< .0005	98.66
41. Sentence structure	1.00	< .0005	100

Note. The reliability values are computed on the raw data from both raters. Both raters agreed on the complete absence of eight cues and the *k* was not informative as both raters' scores were constant values (labelled as --). Additionally, in two cases, one of the two raters scored the value as absent and again *k* was not informative (labelled as -). When *k* was not informative, I instead report percentage agreement.

Results

Cues to Deception

I also used descriptive statistics to explore the self-reported cues to deception used by participants. Supplementary Table 2 provides an overview of the coding of participants' endorsement of these cues for the sample as a whole. The majority of participants reported using cues related to contradictions or inconsistencies, the presence of filler words, and the overall number of details. I was particularly interested in the verbal cues relating to comparisons between the general and critical elements of the statement. I conducted two chi-square tests for association between the two instruction groups and their endorsement of the strategies relating to content-based differences (type or amount of detail) between the baseline and critical period. These analyses revealed that participants, across Baseline-present and Baseline-absent instruction groups, did not significantly differ in their use of cues related to differences between the baseline and critical period in terms of the amount of details or the type of

details, $\chi^2(1) = .53$, $p = .467$ and $\chi^2(1) = 1.51$, $p = .219$. Both associations were weak, $\varphi = .06$ and .10, respectively.

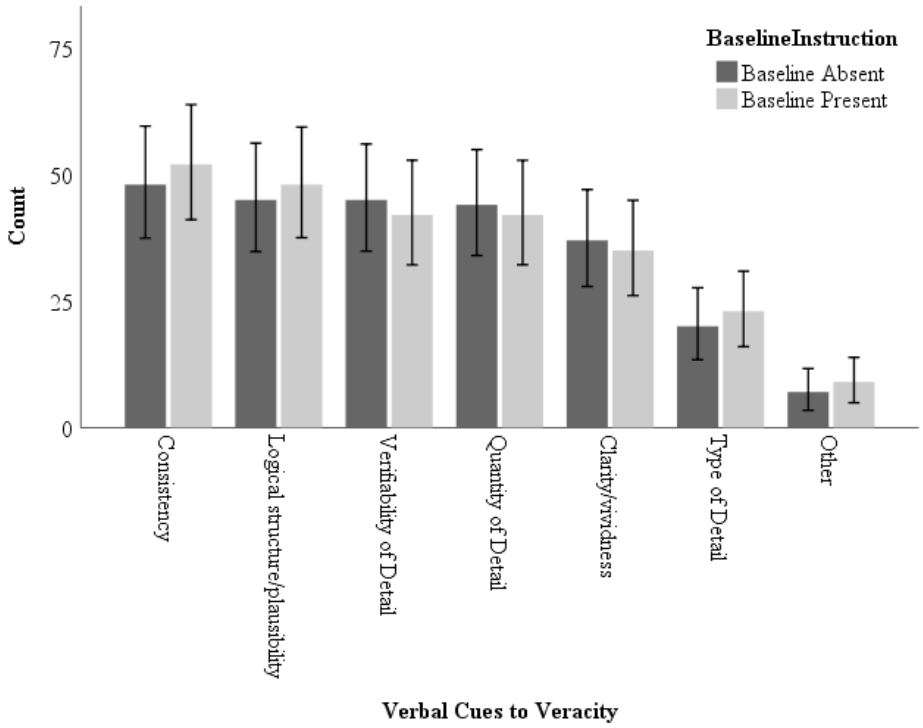
Supplementary Table 2

Participants' endorsement of verbal cues used for their deception judgement

Item	Total Frequency	Relative Percentage
Contradictions or inconsistencies	53	35.8
Filler words indicative of hesitation	47	31.8
Quantity of details	34	23.0
Differences between baseline and critical period: Type of detail	19	12.8
Repetitions	15	10.1
Lack of conviction or memory	13	8.8
Sentence structure	12	8.1
Unstructured production	12	8.1
Changes in language	12	8.1
Missing information	12	8.1
Spontaneous corrections	10	6.8
Plausibility	10	6.8
Temporal information	9	6.1
Verifiability of information	8	5.4
Differences between baseline and critical period: Amount of detail	8	5.4
Coherence	7	4.7
Extraneous information	7	4.7
Specific details or phrasing	5	3.4
Use of pronouns	5	3.4
Clarity/vividness	4	2.7
Unusual details	3	2.0
Evasive responses	3	2.0
Nonsense or not applicable responses	3	2.0
Cognitive operations	2	1.4
Grammatical errors	2	1.4
Unexpected complications	2	1.4
Spatial information	2	1.4
Perceptual information	1	0.7
Emotions	1	0.7
Social introduction	1	0.7
Objective versus subjective time	1	0.7

Note. Although I used the 41 items in Appendix B to categorise the answers, only 31 different items of this list were present within the answers of our respondents.

Finally, I explored participants' cue endorsement from the list of predetermined cues provided (see Supplementary Figure 1). The most common cue was *"Consistency within the statement,"* reported by nearly 68% of participants. To test whether there was a difference in the endorsement of this cue between the two instruction groups, I conducted a chi-square test of independence, which revealed no statistically significant association between the groups, $\chi^2(1) = .49$, $p = .482$. This association was weak, $\varphi = .06$. Thus, participants across groups appear to have similarly relied on the consistency cue in their veracity decisions.



Supplementary Figure 1. Participants' endorsement of veracity cues from a set of predetermined choices. Error bars represent 95% confidence intervals.

Discussion

Our qualitative data regarding participants' use of verbal cues of deception provided only a weak indication of the use of a comparable baseline. Only a small percentage of participants reported using cues related to content-based differences

between the baseline and critical sections of the statements (13% of the sample endorsed verbal cues relating to differences between the baseline and critical period in terms of the *type* of detail and 5% for the *amount* of detail). This could indicate that our baseline instruction was not strong enough to motivate participants' evaluation of statements based on verbal cues between the critical element and the comparable baseline section. It is also possible that the task of retrospectively reporting on higher-order cognitions was too challenging or perhaps the vague nature of our question led to less accurate responses (see Ericsson and Simon, 1980 for a discussion).

Supplementary Table 3

Descriptions and sources of verbal content cues

Verbal Cue	Description	Source
Coherence	Refers to the extent to which all elements of the statement are logical and make up a unified whole.	CBCA
Contradictions and inconsistency	Refers to the extent to which a statement contains elements that contradict each other.	CBCA
Quantity of details	Refers to whether a statement is rich in detail and includes specific descriptions of place, time, persons, objects, and events.	CBCA
Unstructured production	Refers to the chronological order in which the statements is told. Are they told in the same order in which they occurred (chronological), or not (unstructured)?	CBCA
Unexpected complications	Refers to occurrences (caused by the interviewee, a third person, or another situational factor) that make a situation more difficult than necessary, often characterised by disrupted activity, failing efforts, failures to progress and activity, suddenly appearing people and/or obstacles, etcetera.	CBCA
Unusual details	Refers to details of people, objects, or events that are unique, unexpected, or surprising but meaningful in the context.	CBCA

*Description of interaction	Refers to how action and reaction of the different actors presented in the statement are linked.	CBCA
*Reproduction of conversation	Refers to whether parts of the conversation are reported in original form or if the different speakers are recognisable in the reproduced dialogs.	CBCA
Spatial information	Refers to information about locations or the spatial arrangement of people and/or objects.	CBCA, RM
Temporal information	Refers to information about when the event happened or explicitly describes a sequence of events.	CBCA, RM
Spontaneous corrections	Refers to corrections that are made or information that is added to material previously provided in the statement without having been prompted by the interviewer.	CBCA, SCAN
Extraneous information	Refers to irrelevant details that are related to the event, but not necessary to understand the event.	CBCA, SCAN
Lack of conviction or memory	Refers to when the writer is vague about certain elements within the statement when the writer admits he or she has forgotten something.	CBCA, SCAN
Emotions	Refers to information that describes how the participant felt during an event and how these feelings develop and change throughout an event.	CBCA, RM, SCAN
Clarity/vividness	Refers to the extent to which a statement is clear, sharp, and vivid (instead of dim and vague).	RM
Perceptual information	Refers to the presence of sensory information in a statement. Does the statement include sensorial experiences such as sounds, smells, tastes, physical sensations, and visual details?	RM
*Reconstructability of the statement	Refers to whether it is possible to reconstruct the event on the basis of the information given.	RM
Plausibility	Refers whether the story is plausible and realistic and makes sense.	RM

Cognitive operations	These cue descriptions of inferences are made by the participant based on existing knowledge.	RM
*Denial of allegation	Refers to whether the examinee directly denies the allegation in the statement.	SCAN
Social introduction	Refers to how the persons described in the statement are introduced. People that are described within a statement should be introduced in an unambiguous way, usually by mentioning their name and role.	SCAN
*Main event of the statement	Refers to the balance of the statement. In a truthful statement 20% is used to describe activities leading up to the event, the next 50% to describe the actual event, and the final 30% to discuss what happened after the event.	SCAN
Objective versus subjective time	Refers to how different time periods are covered in the statement. Objective time refers to the actual duration of events described, whereas subjective time refers to the number of words used describing these events.	SCAN
Missing information	Refers to phrases in the statement that indicate some information has been left out.	SCAN
*First person singular, past tense	Refers to the format in which a statement is written.	SCAN
Use of pronouns	Refers to the use of pronouns in the statement.	SCAN
Changes in language	Refers to the change of terminology or vocabulary in the statement.	SCAN
*Length of the statement	Refers to the length of the statement.	Literature-based
*Self-references	Refers to the number of self-references made by the interviewee.	Literature-based
Grammatical errors/changes	Refers to grammatical errors within the statement. Also refers to changes in grammar within the statement.	Literature-based
Repetitions	Refers to the presence of word and or sentence repetition.	Literature-based

*Clichés	Refers to the presence of clichéd expressions within the statement.	Literature-based
Evasive responses	Refers to the presence of evasive or indirect responses by the interviewee.	Literature-based
*Self-deprecation	Refers to the presence of the interviewee undervaluing himself or being excessively modest.	Literature-based
NA/ nonsense response	Refers to statements that are not applicable to the verbal cues used, or that don't make sense.	Data-driven
Filler words	Refers to the presence of filler words that may indicate hesitation.	Data-driven
Providing un/verifiable details	Refers to the presence of verifiable or unverifiable (checkable/uncheckable) information.	Data-driven
Differences between baseline and critical period: *Amount* of detail	Refers to the presence of differences regarding the amount of detail included in the general statement compared to the critical element from 1:00-3:00pm.	Data-driven
Differences between baseline and critical period: *Type* of details	Refers to the presence of differences regarding the type of detail included in the general statement compared to the critical element from 1:00-3:00pm.	Data-driven
Specific details/wording /phrasing	Refers to the inclusion of specific details/information or specific wording/phrasing. It also refers to a lack of specific detail/vagueness in the statement.	Data-driven
Sentence structure	Refers to changes to sentence structure. Also refers to the way/style of reporting.	Data-driven

Note. The items marked with an asterisks (*) were included in the coding list but were scored as absent based on the coding of both raters. SCAN refers to Scientific Content Analysis (Sapir, 2005).

Appendix E - Ethical Approval

The studies presented in this thesis were conducted under a research line granted to Brianna L. Verigin by the University of Maastricht's Ethical Committee for Psychology (ECP) in 2016. Below is the letter of favorable opinion for the research line under which each of the individual studies were conducted.[14,15]

Maastricht University Leading in Learning!

Board of FPN
Universiteit Maastricht
Postbus 616
6200 MD Maastricht

Ethical Review Committee
Psychology and Neuroscience

Our reference	*direct dial*	*Maastricht*
ERCPN-173_01_11_2016	0031.43.388.4008	7-12-2016

Dear Board,

After examination of the research line entitled "Where the Truth Lies: An Examination of how the Interaction of Truthful and Deceptive Elements within Statements can Facilitate Deception Detection", submitted by Brianna Verigin, the Ethical Review Committee Psychology and Neuroscience (ERCPN) came to the conclusion that there are no objections to the execution of the research project as described in the said protocol with regard to the review framework used.
The applicant has been informed that:

1. Approval has been granted for a period of five years, with the possibility to prolong.
2. If the approval has been granted for a research line, each individual study within this line must be notified to the ERCPN using the form provided on the website. This does not include studies which are reviewed by a proposal committee (i.e. fMRI, EEG and TMS).
3. Changes to the approved research protocol must be submitted by the ERCPN.
4. The reference number should be mentioned in all correspondence with the ERCPN.
5. The reference number must be indicated on all advertising communications to recruit participants.

Yours sincerely,

Prof. Dr. G. Kok	Mr. M. Schrijnemaekers	Prof. Dr. A.T. Sack
Chair ERCPN	Secretary ERCPN	Board of FPN

Cc. Brianna Verigin

Visiting address	***Email address***	***ERCPN***
Universiteitssingel 40 6229 ER Maastricht	ercpn-fpn@maastrichtuniversity.nl	Chair: G. Kok Executive secretary: M. Schrijnemaekers

[14] The ethical approval of Maastricht University's ECP extends to cover the execution of a research project at the University of Portsmouth (Chapter 4; Study III).
[15] Each individual study within the research line received approval from Maastricht University ECP.

Appendix F – UPR16 Form

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

UNIVERSITY OF PORTSMOUTH

Postgraduate Research Student (PGRS) Information				**Student ID:**	838358		
PGRS Name:	Brianna Verigin						
Department:	Psychology		**First Supervisor:**	Prof. Aldert Vrij			
Start Date: (or progression date for Prof Doc students)	**August 2016**						
Study Mode and Route:	Part-time	☐	MPhil	☐	MD	☐	
	Full-time	☒	PhD	☒	Professional Doctorate	☐	

Title of Thesis:	The Effect of Embedded Lies on the Verbal Quality of Statements and Implications for Credibility Assessment
Thesis Word Count: (excluding ancillary data)	47,645

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.ukrio.org/what-we-do/code-of-practice-for-research/)

a) Have all of your research and findings been reported accurately, honestly and within a reasonable time frame?	YES NO	☒ ☐
b) Have all contributions to knowledge been acknowledged?	YES NO	☒ ☐
c) Have you complied with all agreements relating to intellectual property, publication and authorship?	YES NO	☒ ☐
d) Has your research data been retained in a secure and accessible form and will it remain so for the required duration?	YES NO	☒ ☐
e) Does your research comply with all legal, ethical, and contractual requirements?	YES NO	☒ ☐

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):	ERCPN-173_01_11_2016
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)*: Brianna Verigin	**Date:** December 13, 2019

UPR16 – April 2018