# Emotions and Deception Detection

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I, Mircea Zloteanu, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

*Signature*

## Abstract

Humans have developed a complex social structure which relies heavily on communication between members. However, not all communication is honest. Distinguishing honest from deceptive information is clearly a useful skills, but individuals do not possess a strong ability to discriminate veracity. As others will not willingly admit they are lying, one must rely on different information to discern veracity. In deception detection, individuals are told to rely on behavioural indices to discriminate lies and truths. A source of such indices are the emotions displayed by another. This thesis focuses on the role that emotions have on the ability to detect deception, exploring the reasons for low judgemental accuracy when individuals focus on emotion information. I aim to demonstrate that emotion recognition does not aid the detection of deception, and can result in decreased accuracy. This is attributed to the biasing relationship of emotion recognition on veracity judgements, stemming from the inability of decoders to separate the authenticity of emotional cues.

To support my claims, I will demonstrate the lack of ability of decoders to make rational judgements regarding veracity, even if allowed to pool the knowledge of multiple decoders, and disprove the notion that decoders can utilise emotional cues, both innately and through training, to detect deception. I assert, and find, that decoders are poor at discriminating between genuine and deceptive emotional displays, advocating for a new conceptualisation of emotional cues in veracity judgements. Finally, I illustrate the importance of behavioural information in detecting deception using two approaches aimed at improving the process of separating lies and truths. First, I address the role of situational factors in detecting deception, demonstrating their impact on decoding ability. Lastly, I introduce a new technique for improving accuracy, *passive lie detection*, utilising body postures that aid decoders in processing behavioural information. The research will conclude suggesting deception detection should focus on improving information processing and accurate classification of emotional information.

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## Dedication

- Elena-Any Stanciu -

You guided me, supported me, cared for me, and loved me. This work is a testament to that love. Without your presence in my life I would not have been able to pursue the road that I wanted, and would not have had the skills to accomplish my goals and dreams. If only we had had more time together so you could see the role you played in my life, and the legacy you left behind. I dedicate this work, and all those that follow, to you.

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# Chapter 1: Overview

## Thesis Outline

In the last few years interest for emotions in deception has waned considerably (Ekman & Rosenberg, 2005). The topic of most publications in the past years has moved toward the cognitive approach to detecting lies, primarily due to the ease of experimentally manipulating cognitive load in interrogation scenarios (Sporer, 2016; Vrij, 2008). However, I believe it is premature to limit our horizons and move away from the emotion-based approach to detecting deceit, as it still has much to inform us on the process of veracity judgements and the role emotions have in deception.

The central aim of this thesis is to understand the role that emotions have in the process of deception detection, considering their usefulness and limitations as cues to veracity, elucidate some of the seemingly contradictory findings of past research, and propose new mechanisms through which emotions can be perceived and used in deception. The literature on deception and emotions suggest that liars experience (Ekman, 1988/2009) and portray different emotions from truth-tellers; differences that can produce diagnostic cues to deceit (Porter & ten Brinke, 2008; Porter, ten Brinke, & Wallace, 2012; ten Brinke, Porter, & Baker, 2012). However, accuracy in detecting lies, even when specifically utilising such cues or using individuals that are adept at detecting them, does not result in high level of accuracy (Levine, Feeley, McCornack, Hughes, & Harms, 2005; Warren, Schertler, & Bull, 2009). This apparent contradiction has baffled researchers for the past 30 years.

Currently, this thesis proposes, and will demonstrate, that this disconnect between theory and practice occurs due to a fundamental aspect of human emotion perception. This thesis will provide new evidence for the role that emotional cues have in veracity judgements, illustrating their effect on both accuracy and bias. Secondly, it will demonstrate that liars are capable of utilising and manipulating the emotional cues they produce to benefit their lies, limiting the diagnostic purpose of such cues. Finally, I will demonstrate that behavioural information is still relevant to the process of detecting deception by providing two future avenues of research. I will elaborate on the impact of situational factors on the detection process, and propose a novel method of improving the processing of behavioural information, using embodied postures, as a non-invasive procedure to improve deception detection.

This thesis consists of 8 empirical experiments focusing on deception detection under various scenarios, relating either to behavioural information or specifically to emotional cues in deception. Each experiment deals with an aspect of utilising behavioural information to make veracity judgements, and the impact that specific manipulations, individual differences, or type of stimuli used have on detecting deception.

**Unanswered Questions of the Deception Literature**

The current thesis builds upon current understanding and research in the deception field by addressing key knowledge gaps present throughout. It attempts to elaborate on relevant but underdeveloped concepts, proposes a novel framework for understanding emotions in deception detection, and address how the process of detecting lies can be influenced by seemingly unrelated factors, concluding with evidence regarding the role of information processing in accurate veracity judgements.

Emotion related cues are proposed by the deception literature to be diagnostic indicators of the true intentions of a sender, and thus be useful in ascertaining veracity. However, past research using emotional cues to ascertain veracity finds poor performance. In this thesis I aim to elucidate some of the inconsistencies and contradictions present in the emotion-based deception literature, and address aspects of human veracity judgements that have not been explored fully. A central question of the current thesis is if decoders can perceive emotional information accurately and if it can aid deception detection. Second, understanding how individuals integrate emotional information into their veracity judgments. Third, how much control do liars have over their emotional displays, and can decoders detect the authenticity of such cues. Finally, how does behavioural information influence veracity judgments, and can it be used to improve accuracy and reduce bias.

**Chapter 2: General Introduction**

The first chapter presents an overview of the deception field, relevant concepts, theoretical models of deception detection, and relevant terminology. A brief history of deception research will be presented, followed by the current understanding of the deception process and techniques to detect deceit. This chapter will also briefly deal with the current understanding of strategies that liars utilise, why they choose to lie, and individual differences in liar and lie detector performance.

**Chapter 3: Emotions**

This chapter will be dedicated to outlining how emotions relate to deception and attempts at detecting deception, focusing on assumptions of the field and empirical findings thus far. This chapter will address the factors that are of importance to deception detection and this thesis, as well as issues relating to how decoders perceive—sensitivity to perceiving emotional cues—and judge the veracity of others—accurate decoding of emotional cues. From here the approach of this thesis will be outlined in order to make clear the divergence from past approaches to understanding emotions in deception and their limitations.

**Chapter 4: Multi-Decoder Deception Detection - Exploring the Errors in Veracity Judgements**

An assumption of deception detection research is that while nonverbal cues relating to deceit are ubiquitous (Hurley & Frank, 2011; Porter et al., 2012), they are also scarce (DePaulo et al., 2003), and decoders fail to catch liars due to individual differences in their ability to detect and classify all the relevant, subtle behavioural information that they display (Vrij, 2008). Implicitly, this assumes that decoders can make rational decisions about veracity but are ill-equipped at individually perceiving all the information available, finding it difficult to make accurate decision in situations of uncertainty.

One method of improving accuracy in such low-information scenarios is to use multiple decoders observing the same liar, attempting to pool their knowledge and perception skills to produce improved judgements. However, past multi-decoder research has found no improvements in accuracy, but find decoders working together are overconfident and more lie-biased (Frank, Feeley, Paolantonio, & Servoss, 2004; Park, Levine, Harms, & Ferrara, 2002).

To date, no empirically tested explanation has been provided for these effects. This chapter will address why in deception multiple decoders, unlike in other group judgment scenarios, do not produce improved accuracy, but do result in an increase in confidence and bias. To understand these effects I considered that decoders do not make rational judgements when attempting to judge veracity, and are unable to share diagnostic information. The response biases and overconfidence observed is due to having the sole task of "catching the liar" artificially increasing suspiciousness (Kim & Levine, 2011), and decoders falsely assuming they are more productive than if working alone. The lack of improvement in accuracy is due to the inability of decoders to accurately make joint veracity judgements in situations of uncertainty, and the inability to self-select the strongest decoder in a pair.

The subsequent chapters focused specifically on emotions as the primary source of such behavioural information in the deception detection process, aimed at uncovering the reason for the lack of relationships with perceiving subtle nonverbal cues and accuracy.

**Chapter 5: Emotion Recognition and Veracity Judgements**

Emotions are integral to the process of deception. Liars experience different emotions and employ different strategies from truth-tellers, resulting in differences in emotional cues. The emotion-based approach to detecting deception suggest that if individuals are better at understanding and recognising the emotions of others it will confer an advantage in detecting deception. I argue that these assumptions are an oversimplified perspective on how people make veracity judgements and do not reflect the empirical research, which finds that emotional intensity or presence of emotional cues is unrelated to discriminability of veracity (Hartwig & Bond, 2014; Porter et al., 2012).

This chapter investigates how individual differences in the ability to recognise emotions, both innately and through training, relates to the process of detecting deception. The aim of this chapter is to tackle some of the primary assumptions of the emotion-based approach to detecting deception.

Initially, the research provides evidence that disproves the notion that decoders lack the ability to accurately perceive emotional cues. Additionally, I demonstrate that emotion recognition ability does not facilitate deception detection, and can result in poor detection due the negative impact of empathy on veracity judgements.

Expanding on this, how veracity judgements are impacted by the types of lies decoders see and the knowledge they have regarding emotional cues was investigated. This tested two assumptions of the emotion-based approach: (1) that the low accuracy is attributed to emotional cues not being known by decoders (The Global Deception Research Team [GDRT], 2006), and that training in facial cues improves deception detection (e.g., Ekman, O'Sullivan, Friesen, & Scherer, 1991; Frank & Ekman, 1997), and (2) that decoders perform better at detecting deception when the stakes to the liar are high. The chapter also addresses the criticisms regarding the homogenised stimuli used in deception research, and the lack of decoder comparison on multiple deception scenarios.

The results will illustrate that training in emotion recognition does not facilitate deception detection in either low or high-stakes scenarios. However, differences in accuracy between high and low-stakes scenarios were observed, but in the opposite direction to what is assumed by the literature. Additionally, lies and truths relating specifically to emotional content are better classified by decoders, supporting elements of the emotion-based approach. The data demonstrates that knowledge of cues or low-stakes lies are not the primary causes of low accuracy. I will propose that decoders can recognise and classify emotional cues based on their emotions, but this does not also result in discriminating cue authenticity (i.e. genuine or fabricated).

**Chapter 6: Deceptive Emotional Expressions**

This chapter aims to confirm my proposition that emotion-based approach has not produced improvements in accuracy due to decoders being unable to discriminate the authenticity of emotional cues. It addresses the emotion-based approach from the opposite angle: senders' emotional cues as reliable indicators of deceit. I present two experiments focused on emotion authenticity, investigating the potential strategies liars utilise to generate deceptive expressions of emotions. The underlying hypothesis is that people (i.e. liars) can produce facial expressions of emotions to facilitate their lies; this implies that decoders fail to 'spot' liars as they are unable to discriminate emotional expressions based on their authenticity.

The results of the two experiments demonstrate that liars easily generate convincing expressions of surprise, requiring minimal information to do so (namely, the facial display of the genuine emotion). And, decoders show difficulty in discriminating the authenticity of deceptively generated expressions. It is proposed that determining deceit based on emotional information may not be possible under normal circumstances as decoders are perceptually ill-equipped to determine the veracity of such cues. This work serves as a foundation for a new approach to understanding emotions in deception, providing an improved classification of emotional cues and their role in veracity judgements.

**Chapter 7: Situational Factors in Deception Detection**

This chapter addresses the necessity of expanding the horizons of deception detection research by not discounting behavioural information, demonstrating the importance of situational factors in interrogation settings on suspect perception and accuracy. The aim is to demonstrate the complexity of interactive deception detection, the role of behavioural information on judgement, and the influence of factors that are unrelated to either individual difference in the decoder or liar influencing (negatively) the outcome. This demonstrates that decoders can be influenced by non-diagnostic information when making veracity judgements.

The experiment presented deals with the effect of handcuffing suspects during the interrogation process. It measures the effect on the interrogator's accuracy and suspiciousness towards the suspect in an interactive setting, and compares it to passively viewing these videos either by laypersons or professionals (police officers). The data finds that this simple manipulation can result in significant differences in how liars and truth-tellers are perceived. This research aims to inform the need for future research in deception to consider how situational factors interact with the deception and detection process, and illustrates how deception theory can and should impact real-world policies.

**Chapter 8: Body Postures, Gazing Behaviour, and Deception Detection**

The final experimental chapter demonstrates that decoders are able to detect deception with high accuracy by relying on behavioural information. It focuses on an alternative method of improving deception detection, proposing a *passive lie detection* approach. Using two experiments I outline a new approach to improving accuracy by manipulating the body postures of the decoders. I hypothesises that decoders can achieve high accuracy in detecting deception if they are primed to focus on behavioural information and process this information thoroughly. The hypothesis being that specific body posture, which carry embodied meaning relating to openness to communication, can be used to improve veracity judgements.

The findings support my claims and will demonstrate that a simple postural manipulation affects how decoders attend to behavioural information, and their discrimination accuracy; the data suggests the improvement is a result in differences in gazing behaviour and information processing.

### Chapter 9: General Discussion

This chapter provides a general discussion bringing together the findings of the experiments presented into a general framework for the role of emotions in the deception process. It proposes a new approach to understanding the complex and multi-faceted role of emotions in human decoding and deception detection, the importance of behavioural cues, and information processing to veracity judgements. This chapter summarises the overall contributions of the thesis, and presents theoretical implications, practical applications, and future avenues of research.

### Chapter 10: Future Directions in Deception Research

Finally, the thesis will conclude with a few suggestions for future research, expanding on the current data presented, and proposed beneficial uses of the findings and methodologies employed. I suggest methods of improving accuracy in detecting deception, as well as propose avenues of future inquiry. The chapter concludes with a brief summary of the research presented and major theoretical findings.

# Chapter 2: General Introduction

## General Introduction

Deception research has largely focused on the ability of humans to detect deception in other humans in real-time without the aid of specialist equipment (Bond & DePaulo, 2008). The almost unequivocal finding of this research is that humans are not very adept at detecting the lies of others (Bond & DePaulo, 2006). While there have been many propositions attempting to account for the poor accuracy (Vrij, 2008), an important factor is the lack of diagnostic cues relating to the act of deceiving (DePaulo et al., 2003). Thus far, the deception literature has not found any unique behaviour that systematically relates to deception (namely, the proverbial Pinocchio's nose).

However, while a single definitive behaviour does not seem to exist, the literature has reported the existence of a few reliable cues relating to deception indirectly (DePaulo et al., 2003). More specifically these are nonverbal, paraverbal, or verbal cues relating to affective, cognitive, and behavioural changes that are brought about by the act of deceiving (Vrij, 2008). The assumption of the deception detection research is that utilising nonverbal cues can result in improved veracity judgements. The individuals attempting to uncover the deception are generally referred to as *decoders*.

I began researching deception by focusing on methods of improving accuracy through the uses on nonverbal cues of emotions, the area where many, researchers and laypersons alike, assumed to be most promising (Levine, Serota, & Shulman, 2010). However, the results of this research were not very optimistic. As will be described in the experimental chapters, for decoders, nonverbal cues, especially relating to emotions, are not reliable or diagnostic of deception.

The aims of this thesis relate to how emotional cues influence judgements of veracity. It will provide new evidence for the role of emotions in deception and its detection, explaining the apparent discrepancy between emotional cues as diagnostic of deception and the findings that human decoders do not show a positive relationship between focusing on such cues and accuracy. The findings of this thesis will provide a novel and more encompassing framework of the role emotional information has in the process of deception detection as attempted by human decoders.

***Importance of Detecting Deception***. Research on accurate deception detection impacts many domains, from the legal and justice systems to the general understanding of human social interactions. Researchers have invested great effort into understanding deception and its detection, producing an impressive body of research (for an overview, see Vrij, 2008). Identification of serious deception is crucial for many professions, requiring assurances of not wrongfully convicting an innocent person while the guilty party evades capture (Hartwig, 2011; Kassin, 2012; Kassin & Fong, 1999; Loftus, 2011; Mann, Vrij, & Bull, 2004; Meissner & Kassin, 2002; Vrij, Mann, & Fisher, 2006a; Vrij, Meissner, & Kassin, 2015). Similarly, for medical and psychiatric sectors, being able to determine if a patient is genuinely unwell, malingering, or hiding an illness can have immense consequences, such as not providing the necessary treatment or wasting resources on a fictitious issue (Rogers & Gillard, 2013; Rogers, Gillard, Wooley, & Kelsey, 2013).

Additionally, being honest, in the pure sense of the term, is a rarity in social communication; being able to determine the veracity of the information being provided can have great benefits (DePaulo, Kashy, Kirkendol, Wyer, & Epstein, 1996; Turner, Edgley, & Olmstead, 1975; Waskul, 2009). Indeed, based on the prevalence of deception in many aspects of daily life, it is important to understand when it is occurring (objectively) as well as understand if humans are capable of detecting deception.

***Approach of the Thesis.*** Deception research is broad and multifaceted (for a review of the literature, see Vrij, 2008). While more recent approaches to deception are focusing on technological methods to automate the detection of deceit or guilt (e.g., Burns & Moffitt, 2014), or attempting to manipulate the way suspects are interrogated to magnify differences between liars and truth-tellers (Vrij, 2015), the aim of the current thesis is on understanding the process of human deception detection from the decoding of behavioural information—the sum of verbal, nonverbal, and paraverbal information—in real-time, and unaided by technology.

The studies presented will illustrate how decoders detect deception from interacting with or viewing statements from *senders* (liars and truth-teller providing an audio-video statement), in which the veracity is unknown. The studies presented will involve various types of statements, collected under various deception relevant contexts and situations, some manipulated and some not. Following this, several studies will address the issue of how well senders can generate emotional expressions to facilitate their lie telling, and the implication it has on the emotion-based approach to detecting deception. Finally, the thesis will propose and exemplify the importance of and methods of utilising behavioural information to aid deception detection, and reinforce the need to not limit our horizons in deception research prematurely.

**Definition of Deception**

Deceiving is a prevalent human behaviour and a necessary component of everyday social communication (Ekman, 2005; Knapp, 2006; McCornack & Parks, 1986). Importantly, the majority of deceptive episodes involve relatively innocuous scenarios (i.e. harmless lies, of little consequence), which often go undetected (DePaulo et al., 1996). Interestingly, while people are aware that lying is common (DePaulo et al., 1996), lie detection rates are fairly poor, at around 54% (chance being 50%; Bond & DePaulo, 2006), with very little variation based on age, gender, or experience (Aamodt & Custer, 2006; Levine, 2016).

Deception is defined as the act of deliberately instilling a belief in another individual that the sender knows to be false (Ekman & O'Sullivan, 1991; Vrij, 2008). This formulation clarifies that a lie is classified as such only if the sender is aware that the belief of another does not match what they know to be true. While there are various methods of achieving this goal, as will be discussed below, the relevant component is that the sender purposefully attempts to produce this belief, or conceals the truth, or does not correct an incorrect belief.

**Functions of Deception**

Humans are not the only animal to use deception in some form. Phasmids have evolved to imitate sticks and leafs to blend in with their background, Owl butterflies, as their name suggests, have marking that resemble the face of an owl to scare off predators, while some grass snakes can even feign death to avoid predation. More socially, Tufted capuchins have been recorded using vocalisations meant to signal the presence of a predator to steal food from other monkeys or escape a dangerous encounter. Similarly, a great ape named Koko, whom was taught sign language, when found to have torn out the sink in her enclosure signed to her handler "cat did it" to avoid punishment. The role of lying behaviour in humans is believed to have evolved to aid survival, reproduction, and socialising (Bond & Robinson, 1988).

The top five reasons people decide not to be honest are: to save face, to avoid tension or conflict, to control a social interaction, to control a relationship, and to control power/influence over another (Turner et al., 1975). Deceptive behaviour can be divided into two categories: *self-oriented* and *other-oriented* (Lindskold & Walters, 1983; Vrij, 2007, 2008). Self-oriented lies facilitate the achievement of a desired goal or reward, avoidance of an unwanted loss or punishment, or protection of one's own self-image (i.e. self-deception). These lies can be sub-divided into *egoistic*—for personal gain—or *self-defensive*—to avoid negative consequences; these are the general lies used by guilty suspects, fraudsters, grifters, or importers. Other-oriented lies serve a social function primarily, but may still be considered to be selfish in some form, such as protecting the relationship with another person. These can be further sub-divided into *pleasing*—making someone feel better—or *sheltering*—avoiding hurting someone's feelings (Arcimowicz, Cantarero, & Soroko, 2015).

**Prevalence of Deception**

Lying is a common occurrence in daily social interactions. While this assertion is difficult to test empirically, research consistently finds that people lie often and on a daily basis (Cole, 2001; DePaulo & Kashy, 1998). On average the research suggests people lie around twice a day (DePaulo et al., 1996; George & Robb, 2008; Hancock, Thom-Santelli, & Ritchie, 2004), or even as often as 3 lies every 10 minutes when talking to a stranger (Feldman, Forrest, & Happ, 2002). In more detail, people admit to being deceitful in 27% of face-to-face interactions, 37% of telephone conversations, and 14% of email communications (Hancock et al., 2004).

However, what people consider to be a lie can differ significantly based on their interactional partner (Oliveira & Levine, 2008), and there seems to be great variability between individuals in lying frequency (Serota, Levine, & Boster, 2010). Serota and colleagues found that out of 1,000 Americans that were surveyed regarding the number of lies told in the past 24 hours, half of the total lies told were perpetrated by around 5% of the surveyed sample, and around a quarter of the total lies told were perpetrated by just 1% of the sample, while 60% of the sample reported not telling any lies. This suggests there is a large variability in the decision to lie; that is, some are very inclined to lie often while others not at all.

Similarly, the amount of lies told varies based on the content of the lie. In the diary study by DePaulo et al. (1996) participants lied in a quarter of social interactions, and admitted to lying to around a third of the people they interacted with within a given week. However, participants reported that over 50% of these lies were for self-serving reasons, while only around 25% were for the sake of others. Similarly, the type of lie told varied, as most lies were outright lies/fabrications, and over half of these were for non-materialistic reasons. These studies illustrate the wide variety of lies people tell, the prevalence of lies in daily life, and the use that people have for lying (see also DePaulo & Kashy, 1998; Knapp, 2006).

**The Ability to Lie**

Deception is an aspect of our lives from very early on. While lying is considered to have evolutionary roots, it is also an ability or skill that develops with age, learning, and experience. The ability to lie seems to develop around age six or seven (Salekin, Kubak, & Lee, 2008). Although children are taught lying is a bad behaviour, they show an understanding of what a lie is and its usefulness from an early age, and tend to tell lies that are self-serving in nature. Only later in their development does the role of lying become more varied and complex (Evans & Lee, 2013; Talwar & Lee, 2008; Xu, Bao, Fu, Talwar, & Lee, 2010).

Individual differences can also influence the decision of the liar regarding the best strategies to employ or even if to lie at all, such as their confidence in their own ability, creativity, intelligence, or perception of risk (Riggio & Friedman, 1983; Vrij & Graham, 1997). For example Konrad, Lohse, and Qari (2013) found that if given the choice to lie or tell the truth, individuals that self-report as having a higher deceptive ability chose to lie more often. Similarly, the perceived acceptability of lying in a given scenario has recently been considered a factor in one's decision to lie (Dunbar et al., 2016; Oliveira & Levine, 2008). Interestingly, gender difference in lying strategies and prevalence have rarely been reported, and when found their effect size tends to be quite small (see Vrij, 2008); making veracity decisions based on gender specific information not a viable option for improved detection.

***Demeanour Bias.*** A seminal paper by Levine (2010) proposed that the reason why deception detection is only slightly, but significantly, above chance level is not due to decoder's ability to detect some lies, but due to some liars being very "transparent" (see also Levine, 2016). Research has indicated that certain individuals overall appear less credible, regardless of the actual veracity of their statements, leading to a "demeanour bias" towards them, resulting in more lie judgments (Kashy & DePaulo, 1996; Kraut, 1980; Levine et al., 2011; Riggio & Friedman, 1983; Riggio, Salinas, & Tucker, 1988; Riggio, Tucker, &

Throckmorton, 1987; Vrij, Akehurst, & Morris, 1997; Vrij & Graham, 1997; Vrij, Granhag, & Mann, 2010; Vrij, Granhag, & Porter, 2010).

Indeed, the meta-analysis by Bond and DePaulo (2008) reported that sender's demeanour was a primary determinant of a lie judgement, reflecting that some senders appear less credible regardless of their statement veracity (see also DePaulo & Rosenthal, 1979). Empirically, Levine et al. (2011) conducted a series of studies where they matched senders that were consistently perceived as being either deceptive or honesty with the veracity of their statements, creating perception-veracity matched and mismatched stimuli that they presented to decoders. They found that matched stimuli were detected based on veracity with over 70% accuracy, while mismatched stimuli with under 45% accuracy. This difference in demeanour, while not fully understood, has been mainly attributed to nonverbal and verbal differences that people perceive as relating to honesty (Hartwig & Bond, 2011). However, it should be noted that this difference in demeanour does not impact overall accuracy in situations where detection ratings are averaged across an equal number of honest and deceptive statements (Levine, Kim, Park, & Hughes, 2006).

## The Process of Lying

It is clear that people are better at deceiving than detecting lies, however, successful deception also poses many challenges. Liars must construct a narrative that is consistent with the details of an event, supress divulging information that may be inculpating, and "sell" this deception using all their channels of communication as to maximize their credibility. Due to the complexity and difficulty of such an undertaking, cues to deception – emotional arousal, increased cognitive load, behavioural control, and impression management – are more likely to be generated, revealing the deception.

***Types of Lies and Lying Strategies.*** Lies have many uses and purposes, and individuals can adopt many varied strategies for how to perpetrate a lie. Very few studies have investigated lying strategies in the real world (e.g., Lippard, 1988; Strömwall, Hartwig,

& Granhag, 2006). The strategies people say they utilise when deceiving can be separated into six categories: exaggerating, withholding information, telling half-truths/distorting, outright lying, cheating, and stealing (Lippard, 1988).

Deception researchers separate lies into outright lies (the “standard” lie), exaggerations or embedded lies, and subtle lies (DePaulo et al., 1996). Outright lies are lies in which the sender willingly provides misleading information that the liar believes to be different from the truth. Exaggerations are lies where the facts of a situation are distorted, either through overstating or understanding. Subtle lies can be truthful statements told with the intention of misleading the receiver (Ekman, 1997).

An accurate taxonomy of lies is difficult to achieve and may not be very informative as different researchers or philosophers can have different definition of what a lie is or what the truth is. However, for the scope of this thesis it is important to address a few differences in the types of lies that people can tell, and how they can affect the liar’s behaviour, the lie’s content, and its detectability. Here, I will cover the distinctions that are relevant to operationalising deception.

*Uninstructed/Naturalistic lies.* Deception detection research tend to employ the scripted lie paradigm, where participants are required to lie or tell the truth exactly half of the time. This implies that the sender is asked (i.e. given permission or ordered) to lie, which can influence the lying process and the behavioural cues that may accompany such a deception. This has been argued to reduce ecological validity (Kanwisher, 2009). The use of uninstructed or unsanctioned lie paradigms is meant to alleviate some of these ecological validity concerns. This method places individuals in a situation where lying is an option (which might be advantageous) and waits for individuals to decide to lie. The lies told under this scenario should reflect reality in a much more natural way, which is why they are also referred to as naturalistic lies.

However, unsanctioned lies produce a lower base-rate for lies in a sample, as less than half a sample may choose to lie, thereby reducing experimental control. Consequentially, allowing participants to determine if they lie or not may further confound the data as it may reflect individual differences in lie preference, perceived lie ability, or confidence in their ability to escape undetected. Furthermore, this may influence the types of lies participants choose to tell, as they may focus on information that is unverifiable for the decoder, as well as only lie about aspects they are confident about or care little if detected.

*Instructed/Sanctioned Lies.* A more common approach utilised in deception research is to force participants to lie or tell the truth for the sake of the experimental task. It is important to understand that on occasion an individual is forced to lie, whether they want to or not, due to the circumstances in which they happen to find themselves, therefore, being forced to lie is not an odd situation in which a person can find themselves. Forcing a 50/50 split of lies and truth in a sample guarantees an established base-rate for the study, as well as provides lies from various individuals with various skills and self-perceived confidence in their ability to deceive. Such an approach provides valuable information about differences between liars and the types of lies they construct.

Instructing or sanctioning lies is not without limitations. There is the issue of how the liar perceives the lie. One aspect of deception, which will be discussed in the next sections, is the emotions the liar experiences when deceiving (such as anxiety, fear, and guilt) affecting the production process and detectability of the lie (Frank & Ekman, 1997). However, if a lie is sanctioned by an authority figure (e.g., the experimenter) then the moral transgression issue, risk of punishment, and anxiety from lying might be diminished, enough so that the lies produced differ significantly from naturalistic lies (e.g., Caso, Gnisci, Vrij, & Mann, 2005).

While the criticism towards this paradigm is mainly that the difference in how the liar perceives the scenario will alter their behavioural cues that can betray the lie, resulting in poorer discriminability, empirical work does not support this assertion. Feeley (1996) found no difference in judgement accuracy for interviewers in either sanctioned or unsanctioned lying scenarios. Furthermore, Feeley and de Turck (1998) reported that behavioural cues to deception are found more often in sanctioned than unsanctioned scenarios (e.g., speech error, speech hesitation, and reduced gazing). Moreover, meta-analysis investigating these two types of paradigms reported that the only behavioural cue difference found in 11 studies was that sanctioning a lie influenced the amount of smiling (Sporer & Schwandt, 2007).

Therefore, the research on lying scenarios provides evidence that individuals can be placed in various types of deceptive scenarios, each with their own challenges and benefits, but that overall, regardless of scenarios, detectability of veracity is not highly influenced. Such findings support the claim that deception detection, as poor as it may be, is fairly stable.

**Deception Detection**

There are certain assumption made by the deception detection literature that are at the basis of most empirical research: (1) that there exist behavioural (verbal, nonverbal, or paraverbal) differences between individuals that are being honest and those that are being deceitful, (2) that such behavioural cues are present in all forms of deception, varying only in source, type, intensity, or amount, and (3) that human detectors have the sensory mechanisms, perceptual ability, and cognitive capacity to perceive these behavioural differences. The following sections will address each of these assumptions, setting the framework for the current thesis.

**Behavioural Cues of Deception**

The general definition of indices or cues relating to deception are *behaviours that suggest deception may be occurring*. These are either produced voluntarily or involuntarily by the sender, being further sub-classified based on source and meaning.

***Types of Cues.*** In terms of nonverbal communication there are three major categories into which cues can fall: nonverbal, verbal, and paraverbal cues. Nonverbal cues are cues that are observed from the physical behaviour of the sender (e.g., fidgeting). Verbal cues are cues derived from the content of sender's statement (e.g., amount of detail provided). Paraverbal cues are cues derived from the characteristics of the sender's speech (e.g., voice pitch).

Additionally, past definitions of cues have also focused the source of deception related cues, focusing on either emotional (e.g., facial expressions, manipulators), cognitive (e.g., slower responses, less blinking), or behavioural control (e.g., polite smiles, lack of spontaneity). Each of these sources has their own theoretical approach to understanding the reason for their presentation and the impact they have on the detection process.

***Cue Authenticity.*** Presently, I incorporate another classification relating to the authenticity of the cue itself. That is, if the cue is voluntarily produced in order to facilitate deception or if it is involuntary, and "betrays" the act of lying. This is a distinction that is rarely made within the literature, and lies at the core of the current thesis. Separating behavioural cues based on their authenticity, I propose, can explain a part of the inconsistencies in the literature regarding use of cues and accuracy.

As will be detailed in the next section, liars display involuntary behaviours which are different from those of truth-tellers. The source of these can occur either from affective or cognitive differences. As these behaviours occur involuntarily and spontaneously generated, they can be classified as *authentic cues*. Thus, for the purpose of this thesis and the framework proposed, authentic cues relate to natural, spontaneous, involuntary cues produced by the sender which reflect the genuine affect, cognition, or behaviour at that specific point in time.

These authentic cues can be contrasted with *inauthentic cues*, which are under voluntary control and reflect behaviour that the liar wishes to display to create a false impression. The source of these cues related to behavioural-control. It can be assumed that all behavioural-control cues are deceptive in nature as the sender is attempting to create an image of themselves using controlled, calculated behaviour.

However, the situation is more complex. As will be explained in the self-presentational perspective, even honest senders can use impression management to their benefit. For example, an employee might consider a joke made by their boss to be amusing, but not enough to make them laugh out loud, so they wilfully force a laugh to communicate their affective state to the other person. This would be considered in the deception field as an exaggeration, and not an outright lie. For the authenticity classification, such a behavioural cue would be in line with the genuine feeling of the sender (i.e. amusement), but it was produced voluntarily. Decoding this cue (e.g., a smile) would still provide valuable information to the decoder, and in this case would also reflect the true intentions of the sender. For deception, inauthentic cues are specific cues that the liar portrays in order to facilitate in “selling” the lie, such as attempting to emulate (often unsuccessfully) the behaviour of honest senders. Liars may also attempt to use deceptive cues to either mask or neutralise their true affect (i.e. suppress relevant information). These definitions will be expanded upon in a later chapter of this thesis, and reformulated specifically to emotional information.

The relevance of this authenticity dimension is that for the decoder this complicates matters, as now the process of detecting deception based on nonverbal cues is twofold: (1) detect a behavioural cue, and (2) determine its authenticity. This first aspect is where much of the deception literature has focused. The second aspect of the detection process has been largely overlooked, and it is the aim of this thesis to illustrate the importance that authenticity has on detection and deception perception. This thesis will demonstrate that emotions and behavioural-control cues overlap in a manner resulting in poor detection, especially when the decoder focuses on using emotion-based cues to detect deception.

**Theoretical Approaches to Detecting Deception**

Over the past century multiple important theoretical approaches have been proposed to describe the process of deceiving, the differences in behaviour of liars and truth-tellers, and the source of these difference. Each theory focuses on a different aspect of the deception process, each providing strong claims as to the best method of detecting lies. Each method of detection has value theoretically, and merit in its approach, while also leaving the possibility (even the suggestion) that all the approaches can work together. As the aim of this thesis regards the role of emotions in deception, a substantial portion of the following sections will address the emotion-based approach to deception, while also briefly addressing the other relevant, and not mutually exclusive approaches.

***Nonverbal Communication.*** Nonverbal communication serves multiple purposes in human interactions; mainly, it is seen as a tool for assisting communication, enhancing the sent message (e.g., using illustrators to provide a visual aids for the receiver), communicate in the absence of speech (e.g., using emblems as placeholders for words), show one's emotional state, intent, or even to help the sender find the words they need to communicate (Theocharopoulou, Cocks, Pring, & Dipper, 2015). Nonverbal communication can signal the closeness of a relationship (Mehrabian, 1972), or be used to modify the relationship between two people, such as by displaying cues for intimacy (Andersen, Guerrero, & Jones, 2006; Noller, 2006), or cues for threat (e.g., Frick, 1986). Of note is that the effect of nonverbal behaviour on sender and receiver can occur both consciously (Manusov, 1990) and subconsciously (Knapp & Hall, 2010).

Humans are very good at perceiving and utilising nonverbal behaviour to understand another's thoughts, emotional state (Frank, Ekman, & Friesen, 1993), mood, personality (Todorov, Mandisodza, Goren, & Hall, 2005), and even intentions (Barrett, Todd, Miller, & Blythe, 2005). Observers can even use their partner's behavioural cues to anticipate behaviour, even in the absence of explicit knowledge of the relationship between the cue and said behaviour, even for subtle (less than 1 second) nonverbal signals (Heerey & Velani, 2010). This suggests that perceiving nonverbal behaviour is an intrinsic aspect of human communication.

For deception this is relevant as the act of lying produces visible changes in the behaviour of the liar, implying that the same mechanism by which humans detect and utilise nonverbal information in typical, voluntary communication may extend to perceiving nonverbal behaviours that indicate deceit.

***Four Factor Theory.*** The first developed theoretical account of deception was proposed by Zuckerman, DePaulo, and Rosenthal (1981), referred to as the four-factor theory. Zuckerman and colleagues proposed that deception involves various psychological processes and states that have a significant impact on behaviour. The model elaborates on the three primary sources of deceptive behaviour: (1) emotional reactions, (2) arousal (in later reformulation, due to significant overall, arousal and emotions were combined), (3) cognitive effort, and (4) attempted behavioural control (see also Vrij, 2008).

These factors are considered to each influence the nonverbal, verbal, and paraverbal behaviours of a liar, each relating to a different aspect of the deception process. The factors and their associated process are not mutually exclusive, and can all be present during the act of deception; of note, certain behaviours can be a result of different sources (e.g., pupil dilation can be a sign of arousal but also of increased cognitive load). Each of these factors has independently received much attention in the field of deception, and researchers have constructed independent models of how they affect the liar's behaviours.

***Cognitive Approach.*** The cognitive approach has received much attention recently in the literature, mainly due to the utilisation of the "cognitive interview", which aims to increase the behavioural differences between liars and truth-tellers by manipulating the cognitive demands imposed predominantly on liars through various interview and questioning tactics (e.g., Vrij, Granhag, Mann, & Leal, 2011). Proponents of this approach focus on the differences in cognitive load between constructing and/or telling a lie to simply being honest. The underlying assumption being that the act of deceiving is more cognitively demanding than retelling the truth, resulting in observable differences between liars and truth-tellers (Vrij, Fisher, Mann, & Leal, 2006; Warmelink, Vrij, Mann, Leal, & Poletiek, 2013).

Formulating a lie is much more demanding than retelling a story; it involves constructing a plausible story, one that matches reality to a desired extent and the facts that might be known by the receiver, suppressing information that might incriminate the sender or expose the lie, and structure it in a natural and consistent manner. Finally, the liar needs to be aware of all the information (fabricated and genuine) that they have said, in case they need to recall it at a later point, as to be consistent and not produce mistakes (e.g., slips of the tongue, or inconsistencies).

Secondly, being honest seem to be the default response in the human brain, as neuroimaging studies find that lying requires the inhibition of the truth response and activation of the deceptive process, resulting in increased cognitive demands (e.g., Cui et al., 2013; Yin, Reuter, & Weber, 2016). A meta-analysis of neuroimaging studies concluded that lying is associated with increased neural activity, especially in the prefrontal regions related to executive control and cognitive inhibition (Christ, Van Essen, Watson, Brubaker, & McDermott, 2009). Being deceptive seems to involve two separate cognitive processes: decision making—related to spontaneous deception—and response preparation—a secondary response meant to inhibit truthful response tendencies, and influence behavioural controls (Sun, Mai, Liu, Liu, & Luo, 2011). More recently, it has also been shown that this default response to be truthful is malleable, and can be altered towards a more predominant lie response (i.e. easier to lie) if given enough practice (Verschuere, Spruyt, Meijer, & Otgaar, 2011).

For detecting deception the core of this approach is the *cognitive load hypothesis*, which focuses on the behavioural differences resulting from these increased cognitive demands of generating and sustaining a lie, referred to as *cognitive cues*. The behavioural difference produced as a result of this increased cognitive complexity of deception will be reflected in the behaviour and statements made by liars. In this account, the reduced cognitive resources of liars implies they will appear less natural, such as displaying reduced bodily movement, take longer to respond, and make more errors. For example, Lancaster, Vrij, Hope, and Waller (2013) investigated the effect of asking liars unanticipated questions in an interview setting on statement production, finding that liars' responses contained fewer details compared to truth-tellers. Other reported nonverbal differences resulting from increased cognitive load are a reduction in bodily movement, reduced eye gaze, pupil dilation, slower speech, more speech hesitations and errors, and longer pauses between statements (Vrij, 2008). For a comprehensive overview of this approach, see Vrij, Fisher, Mann and Leal (2008).

A limitation of this approach is that lying is not always more cognitively demanding than being honest. As people lie often, they are accustomed (mentally) to the process, and the differences between being deceptive and honest will be small (McCornack, 1997). Furthermore, studies have shown that lying can be easier than telling the truth in certain scenarios, such that it would require more cognitive resources to be honest (McCornack, 1997; see also, McCornack, Morrison, Paik, Wisner, & Zhu, 2014). Additionally, much of memory relies on the use of schemas which reduce the differences implied from fabricating a memory and recalling one (Sporer, 2016).

The other criticism of employing this approach is the limitation of real-world application, as it requires the modification of the procedural methods employed while detecting deception. The cognitive interview forces the liar to experience increased cognitive demands, such as having them to respond to unexpected questions or maintain eye contact during a statement (Vrij, 2015); however, this requires that interrogators change the questions and procedures they employ without the certainty of success, and the potential loss of other sources of information. Additionally, it is not always possible to manipulate these factors, or ensure that cognitive load is experienced equally by all individuals (e.g., differences in creativity, memory, and verbal skills; see Sporer, 2016). Individual differences, availability to modify interrogation procedures, lack of cooperation from suspects, and potential risk of forehand knowledge of these techniques by liars can significantly impair the usefulness of the cognitive approach to detecting deception.

***Attempted Behavioural Control Approach.*** The attempted behavioural control approach suggest that liars are aware that they are potentially being scrutinised during their deception and attempt to monitor and control their behaviour to reflect that of an honest person (Buller & Burgoon, 1996; Burgoon & Buller, 1994; Burgoon, Buller, Floyd, & Grandpre, 1996; Burgoon, Buller, White, Afifi, & Buslig, 1999; Krauss, 1981). Liars will rely on stereotypical beliefs about the behaviour of an “honest” person, and attempt to portray themselves in a credible manner, being more open, maintaining eye contact, and being friendly and positive (DePaulo et al., 2003).

However, people are rarely aware of how they naturally act and behave when they are being truthful. Ironically, forcing honest-looking behaviour can produce behavioural differences that separate liars from truth-tellers, referred to as *behavioural-control cues*. The lack of knowledge of what constitutes honest behaviour can result in liars behaving in an odd manner. For example, liars are aware that a stereotype that liars ‘avert their gaze’ (GDRT, 2006), meaning they are more likely to wilfully control their gazing behaviour during an interaction, to trick the receiver (see Hurley et al., 2014). However, as liars do not possess knowledge of the exact amount of eye-gaze that signals honesty, their eye contact may appear odd and off-putting. Therefore, due to the planned aspect of these behaviours, their timing, synchrony, fluidity, symmetry, and intensity will not match that of genuine behaviour, appearing out of place and rigid.

Secondly, some behaviours may not be possible under conscious and voluntary control (Ekman, 2009). The classical case of the Duchenne smile (Duchenne, 1862) has illustrated that specific behaviour, especially relating to emotional content, are difficult to reproduce voluntarily. Research on genuine smiles (the Duchenne smile) as opposed to polite smiles has found that there exist facial differences in their presentation which can separate them behaviourally. However, recently it has been demonstrated that such “reliable” markers of genuine behaviour can, to some extent, be voluntarily reproduced at least by some deceivers (Krumhuber & Manstead, 2009).

A limitation of utilising the behavioural control approach is that having more accurate knowledge of behavioural markers of honesty can improve the liar’s ability to replicate these behaviours and reduce the potential discriminability with honest individuals. For example, knowledge of the methods used in verbal analysis may enable liars to produce statements that bear the hallmarks of truthful statements.

***Interpersonal Deception Theory.*** A dynamic extension of the attempted behavioural control approach is Buller and Burgoon’s (1996) Interpersonal Deception Theory (IDT). IDT views deception through the theoretical lens of interpersonal communication, asserting that deception and its detection are dynamic in nature. IDT assumes that in a face-to-face scenario liars monitor not only their own behaviour but also that of the receiver of their message, and that the behaviour of one will affect the other. Liars monitor behaviour to ensure that the lie they are telling is being believed, and if not, to actively adapt and alter their speech and behaviour accordingly. IDT focuses on the dyadic, relational, and dialogic nature of deceptive communication. For the liar, this process involves multiple aspects, such as maintaining the flow of conversations, constructing answers that the conversational partner expects, reducing suspiciousness, manipulating the emotional state of their partner, and concealing any intent to deceive (see Buller & Burgoon, 1996).

This view is not incompatible with the aforementioned factors of deceptive cues, as the authors of IDT were in favour of the three primary factors being the sources of behavioural cues to deception. However, they emphasised that these factors are subject to change as a result of the course of the interaction. For example, if the liar believes their partner is becoming suspicious they may change the way they speak or behave in the hopes of winning back their trust (Burgoon, Buller, Floyd, et al., 1996). More importantly, IDT is the only theoretical account that suggests that the bidirectional nature of a deceptive encounter can influence not only the behaviour of the liar but also the behaviour of the decoder (Burgoon et al., 1999).

This approach is not without its criticism. For one, the model is descriptive more than predictive in nature. At the core of this model there are 18 propositions regarding differences in the liar's behaviour and speech, which have been criticised for being fairly ambiguous. Similarly, while it is a very comprehensive model detailing the interaction between the liar and the decoder, there is no explanatory mechanism at its core. Finally the model has been criticised for not distinguishing between interactive communication, which focuses on the role of situational and contextual factors, and interpersonal communication, which focuses on predicting the psychological state and intentions of another person.

***Self-Presentational Perspective.*** Another perspective relating to behavioural control in deceptive communication is DePaulo's Self-Presentational Perspective (DePaulo, 1992; DePaulo et al., 2003). The underlying assumption of this view is that all forms of communication involve an aspect of self-presentation, both truthful and deceptive, implying that all individuals attempt to control the way they are perceived by others. More importantly, this formulation of interpersonal behaviour implies that both honest and deceptive individuals are subject to the same cognitive and emotional pressures, resulting in similar behavioural cues being present, but generated for different reasons (Bond & Fahey, 1987). This implies that the markers used to detect deception based on the sender attempting to control their behaviour might be less diagnostically valid, as such cues would be shared by both veracities, resulting in more false accusations.

*The Illusion of Transparency.* In opposition to the above view of self-presentation in both veracities, research suggests that while liars take their credibility less for granted in communication settings, truth-tellers tend to believe that their innocence will "shine through" (Granhag, Strömwall, & Hartwig, 2007; Kassin, 2005; Kassin & Gudjonsson, 2004; Kassin & Norwick, 2004; Vrij, Mann, & Fisher, 2006b). This belief is referred to as the illusion of transparency (Gilovich, Savitsky, & Medvec, 1998).

Ironically, this belief that simply being honest will result in the receiver recognising your honesty can result in truth-tellers appearing less credible. Individuals assume that because they are being honest an observer will see this clearly, however, in general even truthful individuals can appear nervous, make mistakes, contradict themselves, and forget details; all resulting in inconsistencies in their stories. Additionally, honest individuals might become hostile towards their interviewer if they feel they are not being believed, resulting in an even worse impression (Toris & DePaulo, 1984). Conversely, liars anticipate the issues that can arise from being unprepared and interrogated so they plan out their lies, and attempt to be more "friendly" in their interaction. Therefore, while liars manipulate their nonverbal and verbal channels of communication, truth-tellers may ignore the importance of self-presentation and rely too much on their transparency being obvious, resulting in discrimination between veracities more difficult for the decoder.

***The Emotion-Based Approach.*** The emotion-based approach to deception detection can be considered the most influential in the field, due mostly to the attention it has gathered in the literature than to its empirical support. This approach relates to the role that emotions have in the act of deception. The basis of the emotion-based approach to detecting deception is the assumption that telling a lie is associated with experiencing different emotions than those experienced when being honest. It proposes that liars will display different emotional behaviour when producing statements and reactions to being questioned than would truth-tellers, referred to as *emotional cues*. Initial research on this topic revealed that telling a lie is more arousing than being honest (DeTurck & Miller, 1985; Ekman, 2009b).

The primary proponent of this approach is Ekman (1988/2009), who suggested that there are three primary emotions related to lying which the sender experiences: fear, guilt, and duping delight (Ekman, 2009b; Knapp, Hart, & Dennis, 1974; Köhnken, 1989; Riggio & Friedman, 1983). These emotions and their associated behaviours are subject to additional factors than can influence their presence, type, or intensity; relevant factors are the situation in which the lying occur, the type of lie told, or the stakes involved in telling the lie (Ekman, 1989; Ekman & Frank, 1993).

*Fear.* In a lying scenario, fear is said to be experienced as a response to *detection apprehension* (Ekman & Frank, 1993)—the feeling that your deception will be uncovered. Knowing that you might be detected while lying, and the penalty for this act, in addition to the truth that will be revealed, results in the liar experiencing strong feeling of fear and anxiety.

The experience of fear is also highly influenced by factors relating to the situation or the liar's perception of the situation. For example, if the liar believes that the person they are attempting to deceive is skilled at detecting lies, or is suspicious of them, then the fear felt by the liar would increase, resulting in more emotional cues. Subsequently, the liar's belief in their own ability to lie can significantly impact their experience of fear. If the liar is sure of themselves, and of the lie they have constructed, then the anxiety and fear associated with telling the lie will be reduced (Ekman, 2009). Rehearsing a lie, or having the act of lying be sanctioned by an external force can also result in a reduction in the fear one would experience while lying. Externally, the stakes associated with the lie are a primary driver for the experiencing of fear (Vrij, 2008). A high risk of being caught can add pressure to the liar to be successful and result in increased fear of being caught, and of what will happen to them (Ekman & Frank, 1993; Vrij, Fisher, et al., 2006).

A limitation of fear as diagnostic of deception is that as an emotion it is not unique to lying. As elaborated by the Othello error (see below), experiencing an emotion and understanding its source are different matters. An honest person may still experiencing fear from being placed in a high-stakes criminal setting, such as a police interrogation, while their fear would not stem from a belief they will get caught, but of one that they will not be believed and will be falsely accused (Ekman, 2009).

*Guilt.* The second emotion that is at the core of this approach is guilt, also a negative valence emotion that is experienced by the liar as a result of their deception. The guilt experienced by the liar is due to either the act of deceiving causing them to perceive their acts as a moral and/or ethical transgression, or caused by the knowledge of the truth of their own actions. The experience of guilt can also be influenced by the receiver of the lie. Research has shown that if the receiver is a close relative, compared to a stranger, the guilt experienced by the liar is intensified (DePaulo & Kashy, 1998; Ekman, 2009).

External factors such as stakes can also influence the liar's experience of guilt. If the stakes are high enough, both in terms of rewards and/or punishment to the liar, it can significantly impact the experience of guilt, as the liar's perception of the severity of their decision to lie intensifies the feeling (Ekman & Frank, 1993). The experience of guilt can also be influenced by the type of lie being told. Research suggests that lies of omissions or concealment are accompanied by reduced feelings of guilt, compared to fabrications (i.e. outright lies; Ekman, 2009; Vrij, 2008), while a sanctioned lie reduces the liar's feeling of guilt, as they believe the lie is justified in that particular instance. This is echoed in terms of the liar's belief that the decision to lie is a morally justifiable one (Vrij, 2008). For example, if the liar believes the person they are deceiving does not share their own values their experience of guilt can be reduced (e.g., Ekman, 2009b; Victoroff, 2005).

*Duping Delight.* The final emotion proposed to be present during deception is duping delight. This emotions differs from the previous in terms of its positive valence. It reflects the excitement that a liar feels as a result of thinking they are "getting away" with their deception and fooling their interrogator (Ekman, 2009; Ekman & Frank, 1993); it can also be derived from a sense of pride in achievement of a successful deception.

Duping delight has been elaborated theoretically less well in the literature, and few have studied it empirically, however, recent research supports that liars do experience more positive emotions than truth-tellers, finding that in certain instances liars exhibit (leak) more facial expressions related to feeling happy, compared to honest pleaders (Porter et al., 2012).

*Leakage hypothesis.* In the emotion-based approach, the emotions that liars experience are said to affect the production of involuntary nonverbal cues that can betray their true feelings. The nonverbal channel that is said to be the most affected by these un-suppressible emotions is the face.

Darwin (1872) suggested that facial muscle activity related to the emotions a person experiences cannot be completely inhibited, and that traces of these intense, underlying emotions will "leak out". The proposition is that certain facial muscles reside outside conscious control, referred to as "reliable muscles". The first to note this phenomenon was Duchenne (1862) and later elaborated upon by Darwin. Darwin observed that while humans are able to control, to a great extent, the movements of their bodies to conceal an emotion, they are unable to exert full control over all muscles, betraying their true feeling. He hypothesised that certain facial muscles were beyond voluntary control and could not be fully inhibited. Leakage is also affected by the intensity of the masked or neutralised emotion experienced by the liar.

The second component of this proposition relates to the wilful activation of certain facial muscles, suggesting that emotional simulations will fail due to an inability to activate the corresponding muscles that naturally occur during felt affect. These propositions are the fundamental components of the inhibition/leakage hypothesis (Ekman, 2003; Ekman & Friesen, 1969).

While highly influential in both academic circles and popular media, empirical support for this hypothesis has been severely lacking. While Ekman and colleagues have proposed that emotional cues relating to leakage are the strongest and most valid cue for detecting deception, they have yet to establish any systematic, empirical data to support such a claim. Frank and Ekman (1997) did report initial findings relating to detectability based on facial expressions using two experiments. They had a set of participants take part in a mock-crime scenario—these are typical deception scenarios where a participant and a confederate are placed in a situation where they can either take or not take money in secret or witness money being taken—and where then interviewed on what had transpired. Half the participants were required to lie while the other half to tell the truth. They coded the videos of liars and truth-tellers that participated in mock crime scenarios using two decoders trained in the Facial Action Coding System (FACS)—a tool for measuring the activation and intensity of specific facial muscles—were able to classify veracity of the statements with 80% accuracy, simply from the presence or absence of negative emotions in the videos. They found that deceptive participants displayed more emotions of fear and disgust, compared to honest participants. However, the second experiment, using unaided human decoders, found they could not detect veracity above chance performance.

Further support for this hypothesis has slowly been seen over the past decades, at least with respect to the existence of leaked cues during deceptive scenarios, if not their dominance as a cue for deceit. Recent work by Porter and ten Brinke (2008), using recording of real-life high-stakes deception, demonstrated the existence of subtle leakage relating to emotions occurring during falsified statements. In all deceptive scenarios they investigated there was evidence of facial leakage in the sender, however the amount was very small in comparison to what Ekman and colleagues suggest (around 2% of the total statement). A subsequent study by Porter and colleagues (2012) found evidence of leakage in 98% of their senders at least once (deceptive and honest). They also reported that the felt emotion also influences the amount of leakage, finding fear and happiness result in the most leakage of all emotions. It would seem that liars are incapable to supressing their emotions, even when instructed to do so. For example, Hurley and Frank (2011) found that deceivers produced more eyebrow raises and leaked happiness more often than truth-tellers, despite being instructed to suppress their facial movement.

However, for discriminability of deception, a recent meta-analysis investigating multi-cue deception detection, failed to find that studies employing emotionally intense lies were easier to detect than studies lacking such stimuli (Hartwig & Bond, 2014). The authors concluded that there was no support for the leakage hypothesis, at least relating to their usefulness as deception cues for human decoders. In contrast to this, studies that have trained participants on detecting brief facial expressions of emotion report 80% accuracy rates in deception detection, and 86% when also training in detecting tone of voice (another emotional leakage cue) (Ekman et al., 1991; Frank & Ekman, 1997). This implies that while untrained decoders may be unable to detect emotional cues, providing specific training might improve detection rates. This assumption will be addressed in Chapter 5.

***Unconscious Lie Detection.*** Finally, a more recent proposition for an approach to detecting deception has focused on the presumed innate ability of decoders to ascertain veracity indirectly. The unconscious, or indirect lie detection approach states that decoders are able to detect deception quite well but are either unable to verbalise this underlying veracity judgement, or are hampered by the constraints of social norms and biases that only influence judgement if asking decoders directly.

Proponents of this approach suggest that having decoder judge veracity indirectly can result in better accuracy (ten Brinke, Stimson, & Carney, 2014). Strategies have been developed to measure this implicit ability of decoders, such as measuring reaction time or asking them indirect questions meant to assess veracity (e.g., if the sender appears to be ‘thinking hard’; Street & Richardson, 2015). While some have argued this approach produces significant results (Granhag, 2006; ten Brinke, Stimson, & Carney, 2014), others have criticised these as spurious and uncorroborated by the data (Franz & von Luxburg, 2015; Levine & Bond, 2014; Moi & Shanks, 2015), or suggest their theoretical underpinning are improperly formulated (Street & Richardson, 2015).

**Summary of Theoretical Approaches**

The theoretical perspectives outlined above demonstrate the relationships between the act of deceiving and the behavioural markers that can be generated from multiple sources simultaneously, which vary in complex ways. The cognitive approach attempts to illustrate the importance of the process of constructing a lie, and the effects this can have on the content of a statement and the behaviour of the liar; however the limitation of this approach is the impact the situation can have on the production of cues relating to cognitive load (e.g., preparation time of the liar, or types of questions asked), as are differences in liars with respect to ease of constructing a lie (i.e. some are better story-tellers than others). Second, the attempted behavioural control approach illustrates the importance of considering the mind-set of the liar and the truth-teller in all scenarios, suggesting that the way a sender perceives a situation, as well as how the receiver responds to the sender, can influence the behaviours and beliefs of the liar. Importantly, it suggests that even a truthful individual can appear deceptive if their behaviour is judged as appearing dishonest, nervous, or inconsistent.

Finally, the emotion-based approach, has been favoured by many researchers even in the absence of rigorous empirical support due to its universal nature (i.e. emotions are portrayed in the same manner by all individuals). The potential existence of cues relating to the genuine underlying emotions of a liar are an attractive notion. The limitation being that while studies seem to support the existence of leakage and facial cues relating to these emotions, human detectors show fairly poor performance in translating this into correct judgements. This issue has been the source of great controversy in the field, and lies at the core of this thesis.

**Stakes to the Liar**

An important moderator that influences the production, type, and intensity of behavioural indices of deception are the stakes surrounding the scenario in which the sender makes his/her statement. Stakes are the rewards to the liar for escaping detection successfully (such as wining at poker by bluffing) and the punishment that they would receive if they are caught (such as going to jail). If the liar is in a situation they believe the stakes to be high, such as a criminal investigation, they might experience increased levels of fear or anxiety surrounding their circumstances and their decision to lie. This will produce more behavioural cues relating to these emotions (Vrij, Harden, Terry, Edward, & Bull, 2001).

Empirical studies have demonstrated that stakes play a role in the detectability of lies. The meta-analysis by DePaulo and colleagues found that motivation, a proxy for stakes, was a highly significant factor influencing cue production (DePaulo et al., 2003). This has been attributed to stakes influencing the emotional intensity the liar experiences and the cognitive load that accompanies such a threatening situation. Stakes may serve to explain why the type of lie is an important factor, as lies about transgressions (usually told in high-stakes), are more detectable than lies about opinions (told in a low-stakes scenario) (e.g., Frank & Ekman, 1997). Therefore, type of lie is less important as is the setting in which it is told, and that decoder performance in high-stakes scenarios is stable regardless of the type of lie told (Frank & Ekman, 1997).

Utilising high-stakes lies is believed to address many of the issues of laboratory based deceptive stimuli, such as the lack of behavioural cues and realistic behaviour that liars display. This has been supported in part by more research utilising real-world high-stakes lies. Mann et al. (2004) performed a study utilising real-world high-stakes videos—statements from criminals—to understand if the detectability of real lies is higher, and what good lie detectors (trained police officers) focus on in terms of sources of information. Their study asked participants which details of the video they used to make their decisions: body, vocal, story, or conduct. The overall accuracy rate for detecting lies was 66% and 64% for truths, significantly higher than the 54% accuracy typically seen in most deception studies using lower-staked lies. Additionally, they found that experience (in terms of years as a police officer) correlated positively with accuracy. With regard to the details decoders used, they found most to report "body" as their primary factor. If taken with the results of Frank and Ekman's (1997) study, cues relating from nonverbal channels seem to be a reliable source of indicators of deception in high-stakes scenarios, and one decoders readily utilise. However, it should be noted that decoders rarely have accurate insight into their own decision making process, even when accurate (Anderson, DePaulo, Ansfield, Tickle, & Green, 1999).

Utilising low stakes scenarios may result in underestimating the usefulness of behavioural cues that would, in real-world forensic scenarios, be effective. Thus far, the literature has proposed that in low-stakes scenarios the results will be a reduced version of their high-stakes counterparts, but follow the same pattern. The argument being that, in low-stakes scenarios, while liars may not be motivated to perform well they also do not experience high levels of cognitive and affective influences as the consequences of their deception and equivalent rewards are not large enough (DePaulo et al., 1996; McCornack, 1997; Vrij, 2000). This should result in fewer behavioural cues. However, studies looking at emotional leakage and other cues to deception report that they do occur, to a lesser extent, in low intensity scenarios, suggesting that leakage may lie on a continuum of emotional intensity (Porter et al., 2012).

It should be noted that the majority of lies told by people are not high-stakes lies (see, DePaulo & Kashy, 1998; DePaulo et al., 1996; Kashy & DePaulo, 1996). It can even be considered that understanding low-stakes lies may be a better approach to understanding deception and its detection, as these better reflect the true nature of the majority of lies.

***Motivational Impairment Effect.*** DePaulo and colleagues argued that in situations where liars are motivated to perform well, such as high-stakes lies, the increased tension from wanting to be believed takes away resources and affects the monitoring of their communication channels, resulting in less control and more cues to deceit. They described this paradoxical effect of the liar's motivation to be believed resulting in increased detectability as the *motivational impairment effect*. Empirical evidence has supported this hypothesis, finding that the more motivated the liar is, and the higher the stakes, the more behavioural cues of deception are produced, and the higher the detection rates (DePaulo, Kirkendol, Tang, & O'Brien, 1988; DePaulo, Lanier, & Davis, 1983; DePaulo, LeMay, & Epstein, 1991; DePaulo, Stone, & Lassiter, 1985; Krauss, 1981). This effect is related to the literature of "chocking under pressure", where the more important it is for the individual to make a good impression or achieve a goal, the more likely they are to freeze or fumble, resulting in a decrement in performance (for an overview, see DeCaro, Thomas, Albert, & Beilock, 2011).

The leakage hypothesis has links to the motivational impairment effect. Motivated liars seem to be worse at deceiving, as they experience more anxiety and pressure to be convincing, resulting in more nonverbal cues for decoders to detect. In support of this, DePaulo et al (1983) reported that modality—the medium through which the lie is presented to the decoder—has an effect on detection; detection was low when presenting only the motivated liars' verbal behaviour to decoders, but higher when decoders were shown nonverbal cues either from audio and/or visual presentations.

However, while the above seem to indicate an effect of motivation on deception in terms of cue production, the meta-analysis by Bond and DePaulo (2006) did not find any effect of motivation on decoders' ability to detect deception. This can be interpreted as either the difference in nonverbal cues produced in high-stakes scenarios not being large enough to impact detectability, or the inability of the decoder to utilise such cues to improve accuracy.

**Decoder Veracity Judgements**

There are many propositions to explain the low accuracy reported in the field. While not fully understood, three issues are given the most attention in the literature: (i) the lack of diagnostic cues to deception (DePaulo et al., 2003), (ii) people's incorrect knowledge of diagnostic cues (Vrij, 2008), (iii) people's reliance on heuristics, biasing their decisions (Levine, Park, & McCornack, 1999).

While cues may not be abundant in deceptive scenarios, the research presented suggested they are present, and differ based on veracity, which under optimal circumstance (e.g., video coding) can produce high discriminability; however, rarely when using human decoders. The second argument of low discriminability of senders is at the basis of the current thesis, and will be addressed in more depth throughout the experimental chapters. This section will elaborate on known factors that influence decoders' veracity decision; specifically, it will tackle the beliefs, biases, and perceptions that people have, as well as factors that can alter them. This is meant to address the second and third assumption of the deception literature, initially dealing with how decoders make veracity judgements, followed by factors that are presumed to influence their decision making process.

***Ability to Detect Deception.*** The seminal meta-analyses by Bond and DePaulo (2006, 2008) found that people are bad at detecting the lies of others, with accuracy on average being around 54%. This seems to be a very stable finding, as the meta-analysis by Aamodt and Custer (2006) found the ability of decoders is not affected by age, gender, personality factors, profession, or even training.

It is unusual for a finding in psychology to be this stable. Most psychological processes and effects tend to be influenced by individual differences, training, type of sample, or method of response, but in deception this findings is extremely stable (Hartwig & Bond, 2014). As surprising is the fact that, consistently, the difference between 50% (chance) and 54% is found to be statistically significant, even when using a small sample size. This significant difference, that has almost become axiomatic of deception research, clearly indicates the presence of a systematic casual mechanism at play. However, to date, there is no widely agreed upon explanation for this finding. This thesis aims to provide more information on this finding, and improve our understanding of the effect that emotional information has on the veracity judgement process.

***Belief about Cues.*** An important issue when discussing human deception detection is the role of prior beliefs on the judgement process. Laypersons (or naïve detectors) hold strong beliefs about cues relating to deceptive behaviour, some of which are very stable across cultures. A study conducted in 75 countries all across the globe found that people associate certain behaviours with cues of deception (GDRT, 2006); however, the majority of these beliefs are incorrect and do not take into account individual or cultural differences

(Akehurst, Köhnken, Vrij, & Bull, 1996; GDRT, 2006; Vrij, 2008; Zuckerman, Koestner, & Driver, 1981). Having such strong prior beliefs can result in an artificial decrease in accuracy, as decoders focus on the wrong information, fail to attend to relevant cues, or misinterpret a cue of honest as one of deceit.

The findings from The Global Deception Team (2006) reveal that the predominant cue that people believe reflects deceptive behaviour is averted gaze (over 65%), followed by nervousness (around 30%). Naïve detectors believe that liars make less eye contact, shift their posture more, use more manipulators (self-touching), produce longer stories, stutter more, make longer pauses, are generally more nervous, are more serious, gesture more, are inconsistent, and, of course, "look up and to the right" (Krauss, 1981; Strömwall & Granhag, 2003; GDRT, 2006; Wiseman et al., 2012; Zuckerman, Koestner, et al., 1981).

As was uncovered, there are very few reliable cues to deception, and most are not shared with the ones stated above. Surprisingly, not all beliefs are incorrect. Notable exceptions are higher voice pitch, pupil dilation, speech errors, speech hesitations, response latency, and inconsistency in statements (Vrij, 2008). This suggests that most naïve decoders could rely on these cues, if present, to determine veracity (see Feeley & Young, 1998).

It is believed that non-diagnostic cues are learned either through incorrect formal training (e.g., police training manuals; Kassin & Fong, 1999), from family members (e.g., "look me in the eyes" while being honest; Einav & Hood, 2008), or from popular media (e.g., TV shows;  Levine, Serota, et al., 2010) leaving individuals believing erroneous cues. Moreover, police training manuals have been shown to train officers to look for inaccurate and misleading cues (Mann et al., 2004). For example, eye contact does not relate to deception in any systematic manner (Sporer & Schwandt, 2007), however this is still a "cue" that is frequently part of training programs (see also Hurley, Griffin, & Stefanone, 2014).

***Confidence.*** Another frequent finding in deception research is that people tend to overestimate their own ability to detect lies (Elaad, 2003). Namely, confidence does not correlate with accuracy in detecting lies (DePaulo, Charlton, Cooper, Lindsay, & Muhlenbruck, 1997; Hartwig & Bond, 2011). This overconfidence in one's ability to detect deception can lead to severe mistakes being made, both in the form of lies going undetected and in terms of wrongful accusations (Weinberger, 2010). This finding is echoed in the studies presented in this thesis, where Chapter 4 will explore a source of this overconfidence, especially in multi-decoder situations, such as in police interrogations or juries. Overall, this suggests that decoders have very little insight into their own abilities, and tend to overestimate their performance on deception tasks (Aamodt & Custer, 2006).

***Variability in Decoding Ability.*** Differences between individuals tend to have an impact on the relationship between two variables or their causal effect(s), however, in deception detection research, accuracy has not been demonstrated to be reliably affected by such individual differences. A meta-analysis looking at over 16,500 individuals in over 100 studies was unable to systematically relate deception detection ability with either age, experience (including professions that deal regularly with lie detection), education, cognitive ability, or gender (Aamodt & Custer, 2006). It seems that, for the most part, personal characteristics do not play a role in how well one can detect the veracity of another person. In terms of consistency, variability in performance within participants tends to be a lot higher than is variability between participants (Leach et al., 2009; Levine, 2016).

*Wizards.* It has been proposed that there are individuals that are extremely accurate at detecting deception, referred to as wizards (O'Sullivan & Ekman, 2004). This proposed select group is defined as any individual that consistently achieve accuracy above 85% in all deception tasks. However, this claim has primarily been theoretical, as no substantial empirical support has been provided. Furthermore, investigating the strategies of "wizards" has produced little insight into how to accurately detect deception (Bond, 2008). Moreover, a recent re-analysis of the limited data on wizards has been argued to simply reflect a statistical artefact, and not a reliable effect (Bond & Uysal, 2007; for a reply, see O'Sullivan, 2007).

*Gender and Detection Skills.* A systematic finding in psychology is that women are superior at interpreting nonverbal behaviour (Sud, 2011). This difference has be attributed to the amount of time women dedicate to observing and interpreting nonverbal cues, compared to men (Hurd & Noller, 1988). The largest difference is found from recognising facial expressions, where women are more accurate at interpreting genuine facial expressions of emotion (DePaulo, Epstein, & Wyer, 1993).

As will be discussed in the emotion chapter, facial expressions are an important source of nonverbal information in deceptive scenarios. Superiority in detecting the emotions of the sender can uncover inconsistencies between what is said and what the sender actually is feeling. However, this female superiority in nonverbal detection has been predominantly investigated on the ability to understand messages that others purposefully convey, such as those in romantic or social scenarios (Hall, 1979, 1984; Rosenthal & DePaulo, 1979). This gender superiority does not seem to be present or useful in scenarios where nonverbal information is more subtle or wilfully produced in an attempt to deceive.

With regards to deception specifically, the finding of gender differences are mixed, some finding women are better lie detectors, such as when interacting with romantic partners (McCornack & Levine, 1990b), but worse than men when detecting lies in strangers (DePaulo et al., 1993). However, no systematic gender differences thus far have been reported (Aamodt & Custer, 2006; DePaulo, Epstein, & Wyer, 1993; Hurd & Noller, 1988). An explanation is that women are less suspicious than men, and more inclined to believe others are honest, which might negate any impact of increased nonverbal sensitivity, or that such cues are ignored in favour of a heuristic to determine veracity. Alternatively, it may be that the cues relating to deception differ from those of other interactions (i.e. authentic versus inauthentic), resulting in no improved detection based on gender.

*Experience with Deception.* One individual difference that many would assume should influence the ability to detect lies is experience with deception, such as working in law enforcement. However, to date, the role of experience or profession on detecting deception has been very mixed, a few favouring increased accuracy (Ekman & O'Sullivan, 1991; Ekman, O'Sullivan, & Frank, 1999; Mann et al., 2004), but mostly favouring no effect on accuracy (Bond & DePaulo, 2006). Indeed, the meta-analysis by Aamondt and Custer (2006) did not find experience or profession to significantly relate to accuracy, suggesting that experience is not a predictive factor for deception detection.

**Factors Affecting Detection**

In this section I aim to separate factors that may be a credible source for the low accuracy from those that have "intuitive appeal" but lack empirical support.

***Lack of Behavioural Differences.*** One explanation for low accuracy is the lack of behavioural differences between liars and truth tellers. The meta-analysis by DePaulo and colleagues (2003) found that out of 158 cues investigated across 130 studies very few were reliably related to deceptive behaviour, and those that were had small to moderate effect sizes. However, many researchers have contested these findings in terms of the types of lies utilised, as they were mostly low-stakes where behavioural cues are said to be reduced (Ekman & Frank, 1993). While cues may not be as scarce, an issue with this arguments, is that even when presenting decoders with high-stakes, real-world liars accuracy does not increase. This suggests that even when cues are present people cannot utilise them (e.g., Porter et al., 2012). The empirical data suggests that cues, while potentially scarce, are present throughout deceptive scenarios, and do not account fully for the low accuracy in detecting deception.

***Lack of Feedback.*** Another explanation proposed for the poor performance of human decoders is the lack of feedback that one receives throughout their life relating to deceptive encounters. In daily life you are rarely in a position where you can determine the veracity of what someone is saying. And, any feedback you may receive will occur much later than the event, usually from a third party source (Park, Levine, McCornack, Morrison, & Ferrara, 2002). This makes any behaviour-veracity learning very difficult (DePaulo &

Pfeifer, 1986; Schmitt, Coyle, & Saari, 1977). This lack of feedback can lead to the sensory ability and judgement process decoders use to not be updated or refined enough for the detection process to be successful. However, researchers have attempted to use immediate feedback in their studies with little success (DeTurck & Miller, 1990). More conclusive evidence against this assumption is that experience or profession does not seem to relate to accuracy; that is even being exposed to liars regularly over extended periods does not improve the innate classification mechanism (Aamodt & Custer, 2006).

It is uncertain why feedback does not aid detection. It may be that deception related cues are so varied and unreliable that no learning can occur, or potentially that decoders are incapable of applying what they learn. Alternatively, decoders may rely on specific heuristics and biases for their decisions which may overwrite any rational, cue based detection.

***Lack of Motivation.*** As most studies investigating deception detection are laboratory studies, one criticism put forward is low motivation of the decoder to be successful. While this would be a valid criticism in most areas of judgement and decision making, for deception most find that participants, even if not given specific incentives to perform well, are keen to attempt to do their best. More importantly, in highly demanding situation, motivation, such as monetary incentives, seems to impair performance (Forrest & Feldman, 2000; Porter, McCabe, Woodworth, & Peace, 2007). For deception, motivation may bias judgement, as decoders may be focused on "catching the liar", and interpret all information, especially from body language, as signs of deceit.

***No Clear Definition of "Truth".*** A more philosophical, but equally relevant issue, is that there is no clear criterion for what constitutes a truth (Bolinger, 1973; Knapp & Comadena, 1979). Conducting research that is meant to uncover the truth is difficult if there is little basis of comparison between purely truthful statement compared to ones that are not. In most scenarios truth is defined by convention and not through an objective set of criteria.

## Detection Errors and Judgement Biases

The above description of behavioural cues and deception theories can create the impression that detecting deceit should be a simple task if one is aware of and can perceive all the necessary information. However, even when given adequate information people are still poor at detecting deception (see Hauch, Sporer, Michael, & Meissner, 2014). More importantly, people are prone to several judgemental biases when it comes to veracity judgements, which can have important impacts on accuracy (Bond & DePaulo, 2006, 2008). This section details to some of the more prevalent and well documented biases that have a significant impact both on accuracy (i.e. overall accuracy) and on differences in veracity judgement (i.e. how well lies are detected compared to truths).

In the deception literature, response bias is usually a measure reflecting the amount of 'lie' or 'truth' responses of a decoder compared to what would be expected given the base-rate in the sample presented (McCornack & Parks, 1986). It represents the tendency to favour a specific answer regardless of the actual veracity of the statements. These are important to consider, because if veracity judgements are hampered by certain factors and phenomena, then any valid information will be non-diagnostic to decoders as it is incorrectly perceived, interpreted, or ignored. This perspective lies at the core of this thesis. I assert that decoders fail to accurately detect deception as they improperly perceive and utilise the available information.

***Response Errors.*** Before addressing biases, two errors need to be described to better understand the effect that heuristics and biases can have on accuracy. Two primary errors that can occur when detecting deception are false positives and false negatives (see Ekman & O'Sullivan, 1991). False positives refer to judging a truthful statement as being deceptive, while a false negative is judging a deceptive statement as being truthful. In everyday scenarios these errors can be trivial, however in a high-stakes forensic setting the consequences of such an error can have devastating results. To this point, even proponents of the emotion-based approach advise caution regarding the confidence decoders in high-stakes detection scenarios (e.g., jurists, interrogators) place on judgements based on nonverbal information (Ekman & O'Sullivan, 1991).

***Veracity Effect.*** The 54% accuracy in detecting deception that has been reported consistently in the literature is based on the averaging of the accuracy for detecting truthful responses and the accuracy of detecting deceptive responses. Levine, Park, and McCornack (1999) demonstrated that if you separate the detection accuracy results based on veracity of the stimulus items you uncover that truths tend to be detected at around 61% (significantly above chance level) while lies at around 47% (significantly below chance level) (see also Bond & DePaulo, 2006). This has been referred to as the *veracity effect*.

Some have argued that the veracity effect is a result of experimental designs employing a 50/50 base-rate for lies and truths, suggesting that the real world base-rate is unknown but may favour truthful scenarios (McCornack, 1997; Stiff, Kim, & Ramesh, 1992). Indeed, research finds that accuracy can be predicted from the base-rate of sample (Levine, Clare, Green, Serota, & Park, 2014). However, I take issue with this approach as it implies human detection occurs only coincidentally due to the stimuli reflecting (unknown) real-world patterns, implying detection is not actually occurring, as you are simply changing the odds that the decoders' biases fit the stimuli. True deception detection should not be dependent on the base-rate of the stimuli, but rather on an ability to correctly identify both truths and lies.

Nonetheless, this research suggests that researchers should consider lies and truths separately when analysing the effects of a given manipulation on accuracy in detecting deception.

***Truth-Bias.*** The higher accuracy in detecting truthful statements does not seem to be one due to improved detection of such statements, but one due to a fundamental human bias to judge most communication as truthful rather than deceptive (Levine, 2014b; Levine et al., 1999; McCornack & Parks, 1986). This *truth-bias* is one of the most consistent findings in the field alongside the 54% accuracy (Köhnken, 1989; Zuckerman, Koestner, et al., 1981).

Theoretical explanations of the truth-bias indicate that it is not a 'bias' per se, but a fundamental aspect of human communication to facilitate the function of language and sharing of information. Language as a tool for communication might not have evolved if the receiver considered that the message conveyed by a sender was likely to be deceptive; they would ignore any such information in favour of other sources (Gilbert, Krull, & Malone, 1990). Unless given reason, people will assume that incoming communication is honest.

Although the truth-bias is near universal in deception studies, it can be influenced and even eliminated, primarily by affecting the level of suspiciousness of the decoder (DePaulo et al., 2003). For example, a study where decoders judged the veracity of salesmen selling products (which made the receiver be more suspicious) found a lie-bias (the reversal of the truth-bias) in their responses (DePaulo & DePaulo, 1989). Similarly, the simple act of informing participants that deception may be occurring seems to increase the number of lie judgments decoders make (McCornack & Levine, 1990a, 1990b; Millar & Millar, 1997). Studies manipulating suspiciousness levels of decoders have confirmed that increasing suspiciousness does improve lie detection accuracy, but hinders truth detection accuracy (Stiff et al., 1992). This suggests that suspiciousness does not eliminate the truth-bias, it simply reverses the direction of the underlying assumption regarding incoming communication.

Interestingly, the meta-analysis by Bond and DePaulo (2008) uncovered that there is large variability in the truth-bias (or "judge credulity") between decoders, more so than in terms of accuracy. Clearly this suggests that bias in deception research, and in intervention studies, must be carefully considered when assessing true accuracy.

*Truth Default Theory.* An additional theoretical proposition is the truth-default theory (TDT; Levine, 2014b), a composite theory which aims to explain why the truth-bias exists. The central premises of TDT are that people tend to believe others and that this "truth-default" is adaptive (Street, 2015). The TDT is an elaboration of the fact that telling the truth seems to be the default "setting" of the human brain, and that lying requires the suppression of this response. This implies that to accurately detect deception one must first overcome this default setting and consider the impact it can have on veracity judgements.

***Lie-Bias.*** As with artificially manipulating suspiciousness, it seems that certain professions or experiences with deception can fundamentally affect the direction and strength of the veracity effect. Studies using interrogators or professionals trained in detecting deception show a reversal of the truth-bias, favouring more lie judgements, which some have labelled the *lie-bias* (Meissner & Kassin, 2002). The lie-bias is manifested as a higher level of suspiciousness of senders, resulting in over half of the items decoders judge to be labelled as lies, regardless of actual veracity.

This effect is also found in studies employing "deception training" (real or not) that focus on "cues to deception" rather than "cues of honesty" (Hartwig, Granhag, Strömwall, & Andersson, 2004; Jaume Masip, Alonso, Garrido, & Herrero, 2009). Once more, this illustrates the flexibility of the bias decoders have in detecting deception, and the importance of considering its existence in veracity judgements.

***Investigator Effect.*** Most modern deception detection studies employ the design where decoders look at videos of liars or truth-tellers instead of directly interacting with the "suspects". These stimuli constitute pre-recoded excerpts of the liar or truth-tellers' behaviours, from which the decoder makes their decision. While this can be seen as reducing the ecological validity of the results, this has been done in order to improve control over extraneous variables, such as differences in decoder ability to interview someone. However, research on deception detection in interactive settings finds that interviewers show an increased truth-bias compared to observers at detecting deception. That is, being part of the interaction seems to increase the likelihood that you consider the other person to be honest (Granhag & Strömwall, 2001; Strömwall & Granhag, 2003).

Indeed, most research finds that detection performance is poorer in interactive than in non-interactive settings (Ambady & Rosenthal, 1992). While not fully understood, this effect is believed to reflect the fact that communication occurs under the premise of an honest exchange of information, such that the interviewer devotes resources to maintain the conversation flow, reducing their ability to judge veracity, or due to a difference in the behavioural cues attended to by interviewers compared to observers (e.g., Buller, Strzyzewski, & Hunsaker, 1991).

***Perceived Motivation of the Liar.*** An additional effect that is present in interactive settings relates to perceived motivation of the liar to be successful in their deception. The perception of sender motivation to lie affects accuracy and bias, where "motivated" senders are perceived overall as being more deceptive, regardless of veracity. This effect is especially pronounced in studies providing decoders with nonverbal information (Hartwig & Bond, 2014).

***The Othello Error.*** A final error relating to detecting deception which is especially relevant to the emotion-based approach is the Othello error (Ekman, 2009b). The error refers to misinterpreting a cue as relating to deception when in fact its source and relationship to veracity is irrelevant; predominantly related to cues of nervousness. Nervousness is a feeling that can be shared by both liars and truth-tellers, and both may show nervous behaviour. In general, the Othello error refers to a cue being detected but inferring the wrong information from that cue. Currently, this definition is considered separate from that of incorrectly inferring the authenticity of a nonverbal cue (as was discussed in the Type of Cues section), as it relates to one accurately recognising a specific, involuntary cue (e.g., expression of fear), but inferring that its sources is due to the person lying (e.g., fear of getting caught) compared to it being cause by the situation (e.g., fear of not being believed).

In sum, there are multiple biases and errors that decoders make, even under optimal circumstance, and all of which can be influenced or altered based on circumstances. This research illustrates the difficulty of decoders to assess veracity accurately, and the problematic nature of introducing manipulations and interventions in the deception detection process. An important component of deception research is to account for such response and perception biases in the data as well as ensure that any technique employed aimed at improving accuracy do not result in an artificial performance gain at the cost of a response bias (Levine, 2014a).

**Criticism of Deception Research**

The study of deception poses many challenges for researchers. Recreating such complex behaviour, maintaining the factors and circumstances that lead to deception is difficult. The deception literature is not without certain general criticisms directed towards both the findings in the field and the way research on this topic is conducted and operationalised. Aside from the ethical limitations restricting the scenarios in which participants (both senders and decoders) can be placed, there are also other limitations and criticisms that have been put forward by other researchers.

In this section some notable, prevalent, and recurring criticisms of the literature will be addressed to understand if they can be considered valid, and have basis in empirical research. This will explain the reasoning behind the methodology employed in the current thesis, and address some of the factors that have “intuitive appeal”, but are non-factors in deception detection.

***Subject of the Deception.*** Typical deception studies involve instructing participants to either lie or tell the truth, usually using a 50-50 split. The lies participants are instructed to tell vary largely, however, a few general themes are always present, such as lies about transgressions, opinions, or intent (Frank & Ekman, 2004; Weinberger, 2010). A popular approach is to have participants lie about the content of an image or video they are viewing (Ekman, Davidson, & Friesen, 1990), while others have participants lie about auto-biographical information (Gregg, 2007), or the ownership of certain items (Akehurst & Vrij, 1999). A standard transgressions paradigm utilises what is referred to as a mock-crime scenario, in which participants are either witnesses or active members in a “criminal” act (such as taking money from a briefcase, or damaging a good), and are subsequently interrogated about their knowledge and actions during the event. The majority of deception studies utilise a dichotomous lie-truth judgement, although, some prefer a scaled honesty rating approach (for a review, see Levine, Shaw, & Shulman, 2010).

Some have argued that these variations is paradigms have resulted in the publication of conflicting findings. For example, some researchers argue that providing monetary incentive to be successful or punishments for poor performance is a good proxy for real-world factors (e.g., Leal & Vrij, 2008). Others argue that only motivation based on identity-related factors (such as values) are representative of the factors that activate relevant cognitive and affective mechanisms which generate behavioural indices of deceit (DePaulo et al., 2003).

To limit the impact of such variations in the operationalisation the experiments presented in this thesis have been kept as close to constant as possible. Furthermore, all variations are fully explained and supported by empirical and theoretical reasons, predicting beforehand the impact on the outcome of the performance.

***Ecological Validity.*** The issue of ecological validity is a topic that is brought up quite frequently in the deception literature. The majority of research in deception is constantly attacked by claims that it has reduced ecological validity, resulting from unrealistic settings, and exclusion of relevant factors; the resulting outcome being unrepresentative of how people lie and detect lies.

The core of such criticisms focus on the use of various deception scenarios, use of low-stakes, sanctioned and instructed lies, set in laboratories, using non-experts (e.g., students), with low motivation (for both liars and decoders), and limited interactivity. This concern extends to the limited generalizability of the laboratory-based studies to other settings (e.g., Buckley, 2012; Frank & Svetieva, 2012; Granhag & Strömwall, 2004; Jayne, Horvath, & Buckley, 1994; Miller & Stiff, 1993; Porter & ten Brinke, 2010).

However, while the critics argue these artificial tasks are the reason for the low accuracy and lack of behavioural cues, this is not reflected in empirical findings. The meta-analysis by Hartwig and Bond (2014) looking at over 40 years of research found no support for such claims. Neither lack of interactivity, use of student samples, nor use of laboratory settings were factors for detectability. The authors concluded that the results of deception research, as it is conducted presently, are not artefacts brought about by the methodology employed.

While this should calm some of the more vocal critics, I will address some of these claims in more detail to understand their role in the deception detection literature.

***Presentation Type.*** One criticism brought forward is the difference in accuracy of deception of decoders based on the presentation modality of the message. There are large and significant differences in accuracy based on the presentation modality used (DePaulo et al., 2003). Studies presenting the nonverbal information to decoders, such as video or audio-video result in improved deception detection, compared to audio only, or transcripts of the deceptive statement. This effect is attributed to the presence of additional diagnostic information (specifically, nonverbal cues) present. This is also reflected in the weight decoders assign to different potential behavioural indices of deception. Alternatively, it has been argued that providing decoders with a rich presentation style (audio + video) might result in reduced detection performance due to the limited cognitive resources that decoders possess being overspent (Dennis & Kinney, 1998). This explanation is related to the interactivity argument, suggesting that in dynamic settings it is more difficult for the decoder to focus on the job of detecting deception, resulting in poorer performance.

As the aim of the current thesis is to investigate the effect of emotional and related behavioural cues on veracity judgments, arguably the best medium to use is audio-video presentation of deceptive statements. As discussed in the bias section, interactivity between decoder and sender can increase decoder bias, therefore using an observational approach is the preferred method to investigate any effects of specific manipulations on deception detection performance.

***Thin Slice.*** A secondary aspect of the presentation type is the "thin slice" criticism, relating to deception studies having decoders make decision from short excerpts of behaviour or statements from liars. This, critics argue, reduces the interactive element of the detection process, might be unrepresentative of their liar's full behaviour, and does not allow the decoder to familiarise themselves with the liar enough to detect their lies. While it is true that baseline behaviour is an important, and often ignored, aspect of deception detection (Feeley, deTurck, & Young, 1995), the thin slice criticism is not supported by empirical findings. The majority of thin slice research has shown that people are very good at inferring traits, affective states, and personality characteristics from short excerpts of behaviour (Ambady, Bernieri, & Richeson, 2000; Ambady & Rosenthal, 1992). Additionally, this accuracy in perception seems to not improve with length of exposure to the behaviour (Carney, Colvin, & Hall, 2007; Rosenthal, 1991).

From non-deception research it is known that thin slice behaviour is sufficient to infer many aspects of individual characteristics, personality, intent, and behaviour. Student samples (as those used in many deception studies) can accurately predict the traits of an authoritarian person (i.e. their instructor) from short, 30s video clips (Tom, Tong, & Hesse, 2010), and determine from a photo presented for 2 seconds if a person has a violent or non-violent past (Stillman, Maner, & Baumeister, 2010). Similar findings are reported for social status (Anderson, John, Keltner, & Kring, 2001), psychopathy (Fowler, Lilienfeld, & Patrick, 2009), and socioeconomic status (Kraus & Keltner, 2009).

More relevant to the current thesis, above chance accuracy in judging affect, using audio-visual or photographic stimuli, is found at under 1-2 seconds (Matsumoto et al., 2000; Nowicki & Duke, 1994; Rosenthal, Hall, DiMatteo, Rogers, & Archer, 1979). In deception research, it has been found that videos ranging from a few seconds to around 5 minutes are enough to determine veracity at the same level as with longer presentation studies. For example, Lambert, Mulder, and Fincham (2014) found decoders could identify infidelity of romantic partners from watching a short 3-4 min video interaction of a couple. The authors suggested that thin slices of behaviour lasting around 1-2 minutes are sufficient for it to be representative of a whole interaction.

Therefore, the evidence thus far in the literature does not show strong reason to assume that the usage of short, thin slices of behaviour to assess veracity has a negative impact of the detection process.

***Limited Information from the Liar.*** Related to the above point is the limited information that decoders receive regarding the liar. If decoders were given a larger sample of the liar's behaviour and background (as would a police investigator) then accuracy might be higher.

Two issues with this belief are that: (1) it is clear that thin slices are representative of liar behaviour, and (2) information overload and limited cognitive resources of the detector can be damaging to veracity judgements. If deception detection is a skill decoders possess, then using thin slice behaviour might be more representative of real-world detection, where information is imperfect, and your ability to detect a specific lie is limited. Furthermore, providing decoders with copious amounts of data to sift through, process, and integrate may hamper their ability to make quick decisions and not result in any significant improvements.

Finally, while there has been recent demands from researchers to include the social interaction component more into deception research (Sip et al., 2010, 2012), starting an increase in interactive designs (e.g., Hartwig, Granhag, Strömwall, & Kronkvist, 2006), a recent meta-analysis did not find interactivity (i.e. face-to-face compared to video detection) to influence accuracy in detecting truth and lies (Hartwig & Bond, 2014). This suggests that accuracy is not hampered by the use of brief non-interactive designs.

***Student Sample.*** Most deception detection studies are conducted utilising videos created using either laypersons or students for their lies and truths. This approach, while widespread, has received severe criticisms due to the assumed difference in sample from that of "real-world liars". The argument is that liars, or more specifically, experienced high-stakes liars (e.g., criminals) might differ significantly in terms of intellect, education, strategy, and performance to that of students that are simply participating in a deception study for credit or a few pounds. This seems like a very valid criticism, one that would be expected to influence both the lies themselves and the accuracy in detecting them (either making students better, due to their education and intellect, or worse due to their scruples and lack of experience with high-stakes lying). However, studies investigating this criticism have found that student samples do not differ to criminal samples significantly. The recent meta-analysis by Hartwig and Bond (2014) found that lies told by non-students were equal in terms of detectability to those told by students.

As for the criticism of the excessive use of student decoders instead of professionals in deception research (see Frank & Svetieva, 2012; O'Sullivan, Frank, Hurley, & Tiwana, 2009), there is no compelling theoretical argument for why such a distinction would impact the decoding accuracy, considering that training and experience does not impact accuracy (Aamodt & Custer, 2006). The only review of the literature to support the claim that experts (i.e. police officers) outperform student decoders is by O'Sullivan and colleagues (2009), finding that expert decoders are significantly more accurate in high-stakes scenarios. However, this paper has been severely criticised by other researchers for its biased sampling, cherry picked results, and flawed methods of analysis (see Granhag, Vrij, & Verschuere, 2015; Vrij & Granhag, 2012).

Thus, the literature supports the validity of using student decoders and student deceivers for the purpose of laboratory-based deception research, without affecting the generalizability of the findings produced. Taken with the previous research, it should demonstrate that while such factors may reflect intuitive expectations, derived from lay beliefs, they are not weaknesses in the operationalisation of deception research.

**Summary**

In summation, this thesis aims to improve the understanding of unaided human deception detection by considering the assumptions of the deception field, specifically of the emotion-based approach, as well as the effect of variables relating to response biases of decoders and perception of liars. I will investigate if the claims made by this emotion-based approach are valid, as well as address the prevalent inconsistencies reported in the literature regarding emotional cues.

# Chapter 3: Emotions

As described in the emotion-based approach section, emotions are an integral part of deception and how it is detected. The focus of this thesis is on the emotions that liars experience, the behavioural indices of such emotions, and more importantly, the way human decoders perceive these cues; of note is the accuracy with which these cues are detected, and how they are integrated into the veracity judgement process.

While there is no consensus on the definition of the term emotion (see Izard, 2007), a general conceptualization is that emotions are physiological processes, with specific action tendencies, and subjective experiences (Lazarus, 1991). Emotions are separate from moods — a general positive or negative state — due to their shorter duration, difference in intensity of experience, and difference in appraisal (Schwarz, 1990; Smith & Ellsworth, 1985).

For deception, emotions are relevant to the detection process due to the behavioural cues generated by the feelings of the liar. Indeed, experimental evidence supports the claim that feelings are a precursor (Moran & Schweitzer, 2008; Schweitzer & Gibson, 2008) and consequence (Ruedy, Moore, Gino, & Schweitzer, 2013; Zhong, 2011) of the act of deception. Subsequently, emotions felt by the liar before deceiving can influence the type of lie and their decision to lie (e.g., Gaspar & Schweitzer, 2013).

## Universality and Basic Emotions

A longstanding debate in the emotion literature is the concept of universal emotions. The supposition that humans share a specific set of innate, basic emotions and corresponding behavioural displays has been a part of scientific research for over 100 years. A basic emotion may be viewed as a set of specific neural, bodily, and motivational components generated rapidly, automatically, and nonconsciously when ongoing affective–cognitive processes interact with the sensing or perception of an ecologically valid stimulus to activate evolutionarily adapted neurobiological and mental processes. The resulting basic emotion pre-empts consciousness and drives narrowly focused stereotypical response strategies to achieve an adaptive advantage (Buck, 1999; Ekman, 1994; Izard, 2007; Öhman & Mineka, 2001; Panksepp, 1998; Tomkins, 1963; Tomkins, 1962; cf. Edelman, 2006).

This is an evolutionary perspective of emotions, presupposing that emotions evolved to facilitate adaptation to specific ecological challenges. The role of an emotional reaction is to motivate the correct behavioural and physiological response in the host that directly assists with the relevant situation (for a review of evolutionary based models, see Tracy & Randles, 2011). However, to date the underlying mechanisms of these emotions is still under debate, as are the exact circumstances that activate discrete emotions (Ellsworth & Scherer, 2003).

More recent neural research and more rigorous, well-executed studies have challenged the discrete emotion approach (e.g., Barrett, 2006; Lindquist, Wager, Kober, Bliss-Moreau, & Barrett, 2012). The new emerging belief is that all emotions have core aspects, characterised by differences in valence and arousal (Barrett & Bliss-Moreau, 2009; Russell, 2003), which are necessary and complementary constructs to the discrete emotions approach (Russell, 2003; Watson, Wiese, Vaidya, & Tellegen, 1999). Some researchers are proposing the distinction between basic emotions and emotion schemas (see Barrett, 2006). However, a review of the literature thus far on emotions seems to support the discrete emotion perspective, at least regarding the cross-cultural presentation and recognition of facial expressions of emotions (Matsumoto, Keltner, Shiota, Frank, & OSullivan, 2008).

***Facial Expressions.*** An important component of the universality perspective is the role of discrete, universal facial expressions of emotion. These are believed to be biological remnants of once-needed behaviours, that originally served the purpose other than that of communications (i.e. they became communicative by association; see Bachorowski & Owren, 2003). Facial expressions are said to be universal in nature as the capacity to recognise their meaning seems to be innate and cross-cultural, regardless of gender, or age (Ekman et al., 1987). Their presentation also seems to follow a specific, prototypical, facial pattern (Matsumoto & Willingham, 2009).

Facial expressions are considered by some to be fixed in a specific pattern that is activated neurologically in response to specific eliciting events (Tomkins, 1962), implying they are universal in nature (Ekman, Friesen, & Hager, 1978). Facial expressions occur spontaneously to specific stimuli, and do not require learning or experience to produce "successfully" (i.e. innate reactions) (Dumas, 1932; Fulcher, 1942; Matsumoto & Willingham, 2009; Rinn, 1991; Webb, 1977). Moreover, research has demonstrated the functional value of transmitting emotional information from the face (Ekman, 2003a; Russell & Fernández-Dols, 1997).

With respect to recognition, facial expressions research has consistently found that the recognition of basic expressions—facial displays corresponding to specific emotions—is significantly higher than chance, with most finding between 81-95% recognition accuracy (e.g., Ekman, 2003b; Ekman et al., 1987; Ekman & Friesen, 1971; Izard, 1971). This recognition is achieved quickly, efficiently, and with minimal cognitive effort (Tracy & Robins, 2008). However, different emotions produce different recognition rates (e.g., Ekman & Friesen, 1971, 1986).

*Darwin.* Charles Darwin was a major proponent of the theory that certain emotions and facial expressions are innate to human behaviour, and form a set of basic emotions. His ideas stemmed from the belief that animals share basic emotions and responses to specific stimuli, which he based on his observations and on the theory of evolution. Darwin believed that the universal or basic nature of emotional expressions is a reflection of the characteristics of the environment to which man has to respond. Darwin (1872) explored the notion that humans display nonverbal behaviours that relate to specific emotional states. Additionally, he posited that emotions were controlled by the human central nervous systems and dictated their representation on the face.

To test this belief he requested the assistances of missionaries posted in 36 remote regions devoid of substantial access to European culture, the purpose of which was to investigate remote settlements for the universality of certain emotions, and found that indeed there were commonalities in all cultures observed (Darwin, 1872). While his initial work was rudimentary and lacking in methodological rigour, it has no less paved the way for modern science to illustrate that specific expressions of emotion are cross-culturally represented and recognised. Darwin's work was highly influential in the field of emotion and our understanding of communication.

*Ekman.* Paul Ekman has been credited for providing the first theoretical account of cues to deception, being the first to separate "thinking" (cognitive) cues from "feeling" (emotional) cues. His most influential work has been on emotional cues related to deception, in the form of facial expressions of emotions that the liar experiences during the act of lying. Expanding on Darwin's work on facial displays representing underlying emotional states, Ekman focused on the potential universal nature of these expressions (Ekman & Friesen, 1971). Ekman and Friesen proposed the existence of around six universal facial expression of emotions: Anger, Disgust, Fear, Happiness, Sadness, and Surprise; later adding Contempt to this list (Ekman & Friesen, 1986; Ekman & Heider, 1988), and speculated the potential for at least 16 other emotional displays related to positive emotions (Ekman, 2003c).

The core of Ekman's proposition was that these facial expressions are invariant to culture and experience, and are therefore expressed in the same manner by all individuals (see also Matsumoto & Willingham, 2009). This is a position that is much more polarised than that of Darwin. Ekman and Friesen (Ekman & Friesen, 1971) conducted several studies to produce support for their claims of universality. They showed photographs depicting various prototypical facial expressions of emotions to individuals from various countries and cultures, to see if they classified the same expression as representing the same emotion. These facial expressions were produced from prior research on the prototypical nature of facial displays relating to specific emotions, however, it was not known if these were only prototypical to western cultures or not.

The results of the cross-cultural study supported their claim of universality, as individuals from all the tested countries and cultures showed convergence on the same set of emotions relating to the same photographs of facial expressions. However, the limitations of this initial finding was that although the culture of the countries utilised (i.e. Brazil, USA, Japan, and Chile) were fairly different, they all had access to western influences which might have biased the results. That is, the study may have measured "recognition" of popular expressions instead of an ability to "detect" universally displayed innate human facial expressions.

Ekman and Friesen expanded on their first study, attempting to eliminate the cultural criticism, by testing how people untouched by western culture would react to these expressions. They located a remote, preliterate tribe—the Fore of New Guinea—that had no formal knowledge of the western world, little prior interactions with outsiders, and no known language with western influences. They utilised skilled translators to convey a story depicting the emotional tone of each facial expression photograph. The translators had the job of telling stories that were meant to elicit specific emotions, then participants (two groups of natives; adults and children) indicated which of the facial expressions from a set of three photographs corresponded to how they were feeling. The data demonstrated similar results to those from the original (predominantly western) sample, providing strong evidence for the universal nature of the facial expressions of emotions that Ekman and colleagues proposed, and giving credence to the universality hypothesis.

This view of universal and discrete facial expressions of emotions has received a lot of attention in the scientific literature, and has shaped research and clinical approaches, as well as the media's portrayal of emotions.

***Display Rules.*** Ekman and colleagues later reformulated their stance on the universality of expressions, conceding that culture can influence presentation, in the form of *display rules*. These are specific cultural norms relating to the type and intensity of emotions that can be displayed (Ekman & Friesen, 1971). Research suggests that specific socially learned mechanisms dictate how emotional displays are managed (Fischer & Manstead, 2008; Koopmann-Holm & Matsumoto, 2011; Niedenthal, Krauth-Gruber, & Ric, 2006).

An important aspect of display rules is that they contain an interactive component. That is, the sender only supresses socially unacceptable expressions if they believe they are being observed (Ekman et al., 1987). For example, the expression of shame is suppressed to a greater extent in individualistic cultures, where it is perceived as a sign of social ridicule, than in collectivist cultures, where they perceive the shame expressions as a reflection of being humble are less restrictive with the display (Tracy & Matsumoto, 2008).

***Microexpressions.*** As discussed in the previous chapter, facial expressions of emotion are considered a strong source of deception related information. The inability to supress facial expression, in combination with the inability to activate specific facial muscles on command is fundamental to the inhibition hypothesis (Ekman, 2003a). This notion served the basis for Ekman's extension into the field of *microexpressions*–split-second (1/25$^{th}$ of a second), full-face expressions, theorized to reflect the genuine emotional state of the sender, which they are trying to conceal (Ekman & O'Sullivan, 1991).

Ekman and colleagues suggest that microexpressions are the strongest and most reliable cue to detecting deception (Ekman & Friesen, 1969). Thus far, this claim has gone mostly untested. The few studies utilising microexpressions find that their recognition can be improved with training (Hurley, 2012), and their recognition relates to improved deception detection (Endres & Laidlaw, 2009; Matsumoto & Hwang, 2011), but, most are correlational in nature, while others do not find such effects (Warren et al., 2009). This will be explored in more detail in Chapter 5 and 7.

While Ekman claimed microexpressions are cues to deceit, as they reflect leaked emotions that the liar wants to hide (e.g., Ekman, 2006), ten Brinke and Porter (2012) found very few brief expressions (2% of the time), and found them equally in deceptive and honest scenarios. Furthermore, Porter, ten Brinke, and Wallace (2012) did not find any complete microexpressions when looking closely at multiple instances of lies and truths in real-world settings, finding only partial expressions. Moreover, all of the detected expressions lasted longer than the 1/5$^{th}$ of a second predicted by Ekman and colleagues (however, see Yan, Wu, Liang, Chen, & Fu, 2013). These results suggest that, while microexpressions may signal genuine emotions, they are rare, more ambiguous, and not exclusive to deceptive episodes, minimising their diagnostic value as cues to deceit. Porter and colleagues did suggest that subtle expressions (longer lasting, partial expressions; Dimberg & Thunberg, 1998; Ekman, 2003a) occur more frequently during communication, especially in emotionally intensive situations, and last long enough to be perceived by the human eye.

**Criticism of Universality**

In psychology it is very difficult to argue in favour of a specific attribute being universal. Without exception, the universality hypothesis has also been challenged in terms of its ability to explain real-world phenomena and in terms of the research supporting its claims. Some in the scientific community claim that emotions are highly influenced by culture, experience, and learning, thus cannot be attributed to an innate form of expressions (see Barrett, 2006). The primary issue is the definition of basic emotion and exactly what this implies. To date there are still active debates regarding the exact definition of an emotion (Ortony & Turner, 1990), of the valence of emotions, and of an agreed upon list of basic emotions (see Lindquist, Siegel, Quigley, & Barrett, 2013).

Critics argue that past research on universality is flawed due to its use of forced-choice responses, dubious methodology, and reliance on literate societies with strong western influences. For example, recent work using indigenous societies and facial expressions recognition failed to find support for universality (Crivelli, Jarillo, Russell, & Fernández-Dols, 2016; Gendron, Roberson, van der Vyver, & Barrett, 2014b). A recent review of 57 data sets found that while a few emotional expression (namely, happiness and surprise) are cross-culturally well recognised, no strong conclusion in favour of the universality hypothesis could be made (Nelson & Russell, 2013).

Although, even critics have agreed that emotions, such as happiness, are recognised cross-culturally at very high levels, even in the absence of forced-choice, and are best explained in terms of evolutionary approaches (Barrett, 2006; Russell, 1995). Furthermore, a meta-analysis conducted on 1,500 articles on emotions supported the universality conclusion (Lench, Flores, & Bench, 2011). While this too has been criticised (Lindquist et al., 2013), and defended (Lench, Bench, & Flores, 2013). Additionally, while another meta-analysis reported that universality seems to be supported, cultural difference (in the form of in-group advantage) exist (Elfenbein & Ambady, 2002; however, see Matsumoto, 2002). Furthermore, evidence for basic emotions is not limited to facial expressions, as studies investigating vocal expressions of emotions find support for this hypothesis (e.g., Sauter, Eisner, Ekman, & Scott, 2010; Scherer, Johnstone, & Klasmeyer, 2003). However, emotional vocalisations have also been found to have cultural variations (Gendron, Roberson, van der Vyver, & Barrett, 2014a).

Evidence for the discrete emotions account has tended to come from neuropsychological studies on patients with focal brain damage, such as the role of the amygdala in fear responses (Adolphs et al., 2005; Whalen et al., 2001, 2004; Whalen & Phelps, 2009), orbitofrontal cortex in anger (Berlin, Rolls, & Kischka, 2004), or of the insula in disgust (Calder, Keane, Manes, Antoun, & Young, 2000; Caruana, Jezzini, Sbriscia-Fioretti, Rizzolatti, & Gallese, 2011; Keysers et al., 2004). However, more recent neuroimaging studies have found more mixed results, some in favour of discrete neural activity for specific emotions (Fusar-Poli, Placentino, Carletti, Landi, & Abbamonte, 2009; Phan, Wager, Taylor, & Liberzon, 2002; Vytal & Hamann, 2010), while others finding overlapping activity (Murphy, Nimmo-Smith, & Lawrence, 2003).

Criticism from neural data of discrete emotions shows that certain emotions, such as sadness and fear, share core affective properties (Wilson-Mendenhall, Barrett, & Barsalou, 2013). Although, temporal dynamics studies report that neural signatures of basic, discrete emotions emerge when assessing activation based on milliseconds instead of time-independent structures (Costa et al., 2013). This is turn contradicts the findings of Krumhuber and Scherer (2011), finding that the concept of fixed patterns of facial responses does not hold, as several components of basic expressions are shared.

A more recent iteration of the criticism for universality is the dialect theory of emotions (Elfenbein, Beaupré, Lévesque, & Hess, 2007). This proposition argues for cultural differences in the expression and recognition of facial expressions, suggesting that there exist cultural in-group advantages to the recognition of emotions of other in-group members. This suggests that facial expressions serve as communicative signals instead of evolutionary bi-products. Elfenbein, Beaupré, Lévesque, and Hess (2007), utilising posed expressions, reported two studies in which culture modulated the muscle activation related to specific emotional expressions and their subsequent recognition by in-group and out-group members (finding in-group superiority and similarity). The authors separated dialects from display rules, as the latter refers to supressing and controlling which emotional displays are appropriate given the culture, while dialects reflect differences in production and display (namely, different facial muscle activation; see also Elfenbein & Ambady, 2002; Matsumoto, 2002).

However, this research has been criticised for not being generalizable to spontaneous (naturally occurring) emotional displays (Matsumoto, Olide, & Willingham, 2009), suggesting that the dialect theory focuses on more social emotions (such as shame or embarrassment) which require an audience to be generated. In this view, emotions that serve social relationships need to be clear signals to others, developing cultural differences to improve their recognition. Alternatively, it has been argued that cultural differences can be better explained by investigating the frequency with which specific emotional expressions occur in everyday life. This perspective argues that recognition differences are a result of experience with a specific facial display, and that different cultures may have differences in the frequency of certain emotions (see Calvo, Gutiérrez-García, Fernández-Martín, & Nummenmaa, 2014).

Such criticisms are important to consider, as the underlying argument favouring the emotion-based approach to detecting deception is the fact that emotional cues are universal and applicable for all senders, irrespective of gender, age, culture, or ethnicity. While the source of these emotional displays is subject to a ferocious debate, the outcome is unchanged: emotions are represented on peoples' face, both liars and truth-tellers, in similar facial configurations, which people are adept at recognising and decoding. For this thesis, emotions are considered as voluntary and involuntary affective cues that decoders can recognise in others, providing valuable information, be it diagnostic or biasing.

**Deceptive Facial Expressions**

As discussed above, the human face allows for complex displays, using the presence or absence of specific facial muscle contractions to produce emotional displays (Willis & Todorov, 2006). While facial expressions are considered to be innate, emotion regulation can be considered to have arisen as humans developed higher cognitive function and social behaviour.

An often overlooked aspect of facial expressions in deception is that humans have evolved to control their facial muscles (Smith, 2004). Out of all nonverbal channels, facial expressions are under most conscious control (Zuckerman, DePaulo, & Rosenthal, 1986). Humans dedicate significant attention to their own facial expressions and to perceiving others' facial expressions, compared to other nonverbal channels (Noller, 1985).

Primate research suggests that facial mobility is predicted by group size (Dobson, 2009), suggesting it evolved to serve a social function. However, it is difficult to argue that emotional expressions came about as an adaptive signal; the possibility remains that they occurred accidentally. If they are true signals they should be moderated by context, as signals require receivers (see Dezecache, Mercier, & Scott-Phillips, 2013). Similarly, if they are signals then individuals should have some ability to inhibit them as to not provide an enemy with information.

Deception often is accompanied by the simulation of unfelt emotions or the concealment of genuine emotions to correspond to the false message (ten Brinke et al., 2012). Emotions in deception can be controlled in three primary ways: (i) *masking*, is replacing a felt expression with another, false emotional expression, (ii) *supressing*, is maintaining a neutral face while experiencing a genuine emotion, and (iii) *posing*, is displaying an emotion in the absence of experiencing that specific emotion. Research also finds differences in the ease with which liars can utilise these. For example, masking has been found to be more difficult to supressing (Porter & ten Brinke, 2008). However, this area has gone mostly unexplored in terms of how liars utilise emotional displays and their prevalence in various lying scenarios. This will be a source of inquiry for the current thesis.

While researchers have suggested that some emotional signals cannot be voluntarily produced, such as a genuine smile (Ekman, Roper, & Hager, 1980; cf. Krumhuber & Manstead, 2009), the involuntary argument seems to hinge predominantly on the one example: the Duchenne smile. There is no evolutionary reason why voluntary facial control would not have evolved (Izard, 1994). For example, neural research has shown that there are neural and motor pathways dealing with voluntary facial muscle control, which are distinct for voluntary and involuntary production (Rinn, 1984). While this can suggest that voluntary and involuntary expressions can have different presentations, as they are controlled by different systems; research on detecting these differences is largely absent in the literature.

While the ability to regulate or control our emotional expressions is considered to be innate, developmental research tells us that the basic emotion response system is influenced by developmental change. As an infant develops, emotions are influenced by cognitive and motor activity, allowing for inhibition and modification of production (Ekman, 2003a; Izard, Hembree, & Huebner, 1987). Ekman suggested that emotional control only appears in the form of suppressing certain displays based on societal or cultural rules (i.e. display rules; Ekman & Friesen, 1986). Additionally, it is believed that producing dishonest emotional signals can be very difficult and costly (Hauser, 1997; Owren & Bachorowski, 2001, 2003). However, Ekman and Friesen (1974) did not discount the possibility of liars using the face to assist in deception. Indeed, people adept at expressing emotions via facial expressions are generally perceived as being more credible (Riggio & Friedman, 1983).

Liars may attempt to deceive using fabricated expressions, however, their ability to produce them is limited, as is the ability to supress genuine expressions. In support of this suggestion, ten Brinke and Porter (2012) found deceptive pleaders attempt to produce expressions of sadness to assist in “selling” their lies fail, and their displays resemble more the expressions of surprise. Porter, ten Brinke and Wallace, (2012) also showed that genuine emotions are the most difficult to supress, and more likely to produce leakage when emotional intensity is high. This resonates the findings by Ekman, Friesen, and O’Sullivan (1988) on inhibition, finding that nurses, when watching graphic videos and asked to suppress their reactions, could not supress their emotions of disgust and produce a genuine smile, they instead produced a “masking smile”.

The notion that emotional cues only reflect genuine affect, and thus are diagnostic to deception, has been at the core of the emotion-based approach to detecting deception since its inception. During this thesis I will provide evidence and theoretical explanations for why this assumption does not hold, and demonstrate the necessity of restructuring how emotional information is seen in deception.

**Emotion Recognition**

Emotion recognition, the ability to quickly detect the emotional signals from facial expressions of another, is considered to be an evolutionary mechanisms serving the purpose of identifying emotional states and anticipating future actions. Accuracy in recognising facial expressions seems to be higher than recognising other expressive information (Fridlund, Ekman, & Oster, 1987). Importantly, people give preferential attention to facial information relative to other nonverbal channels. That is, when there is conflicting or mixed information communicated via different channels of communication, information from the face carries more weight (Carrera-Levillain & Fernández-Dols, 1994; Fernández-Dols, Wallbott, & Sanchez, 1991; Mehrabian & Ferris, 1967).

Newborns innately attend to faces, and even prefer them to other stimuli (Kagan & Lewis, 1965). However, infants' ability to recognise expressions is rudimentary, gradually improving with age (Feldman, Coats, & Spielman, 1996; Lenti, Lenti-Boero, & Giacobbe, 1999; Philippot & Feldman, 1990). The source of this improvement is complex, but, it is generally attributed to the development of the relevant cognitive and perceptual mechanisms in the brain, as well as increased exposure and practice with such social stimuli in daily life (Nelson & de Haan, 1997; Walker-Andrews, 1997).

Accurate recognition of emotions is important for effective social interactions and communication (Hall & Bernieri, 2001), and has been linked to many beneficial social and emotional outcomes (for a review, see Hall, Andrzejewski, & Yopchick, 2009). Research on individual differences in emotion recognition find those whom are proficient at decoding nonverbal and verbal emotional cues are better socially adjusted, have fewer mental health issues, have better relationships, and even higher salaries (Boyatzis & Satyaprasad, 1994; Byron, Terranova, & Nowicki, 2007; Carton, Kessler, & Pape, 1999; Halberstadt & Hall, 1980; Nowicki & Duke, 1994). Conversely, deficits in emotion recognition have been linked with increased antisocial behaviour, increased social anxiety, depression, and lower self-esteem (McClure & Nowicki, 2001; Nowicki & Carton, 1997; Nowicki & Mitchell, 1998).

For deception, the ability to recognise emotional cues has been found, in certain scenarios, to positively relate to improved accuracy (Ekman & O'Sullivan, 1991; Frank & Ekman, 1997; Warren et al., 2009). This topic will be covered in greater detail in Chapter 5.

***Gender Differences.*** A systematic finding in emotion recognition research is that women outperform men at detecting emotional information (from virtually every medium) (Hall, 1978; Rosenthal et al., 1979; but, see Lambrecht, Kreifelts, & Wildgruber, 2014). This effect seems stable even at different age groups; two reviews of the literature found that women outperformed men even when using infant, children, or adolescent samples (Hall, 1984; McClure, 2000). With respect to facial expression research, this female decoding advantage is also very stable (Hall & Matsumoto, 2004; Kirouac & Dore, 1985; McClure, 2000; Miura, 1993; Montagne, Kessels, Frigerio, de Haan, & Perrett, 2005; Proverbio, Matarazzo, Brignone, Zotto, & Zani, 2007; Rotter & Rotter, 1988; Vaskinn et al., 2007; Williams et al., 2009). However, this difference, while significant, accounts for less than 4% of the total variance in decoding accuracy (Hall, 1978), and more carefully controlled studies do not find any advantage of gender (Derntl et al., 2010; Wild, Erb, & Bartels, 2001).

While it could be argued that gender differences in emotion recognition may translate into differences in deception detection (either in terms of accuracy or response bias) research on decoding rapidly presented emotions (such as microexpressions) find no gender difference (Sawada et al., 2014). This suggests that even if gender differences influence emotion recognition (even slightly) it does not translate to detecting emotional information relevant to deception (e.g., leaked expressions). Furthermore, as was reviewed in the deception literature, gender does not predict either accuracy or response bias (Aamodt & Custer, 2006).

***Empathy.*** An important individual difference that is of relevance to emotion perception and recognition is empathy. A precise definition of empathy continues to escape unified scientific agreement. Many thematically similar but different definitions exist (e.g., Decety & Lamm, 2006; Ickes, Stinson, Bissonnette, & Garcia, 1990; Marangoni, 1989; Wispé, Knight, & Roberts, 1986). At its simplest, empathy can be described as the ability to perceive and understand the emotional states and perspectives of others (Banissy, Kanai, Walsh, & Rees, 2012). A more general and encompassing definition, which retains the core aspects of most conceptual definitions, is that empathy is an ability to perceive and interpret, with accuracy, the affective states of another person (Decety, 2004; Singer, 2006).

A commonality throughout definitions of empathy is that it is has two primary components—emotional and cognitive. The emotional component represents the experience of an emotion that the person has in response to another's emotional states (i.e. to 'feel' what the other person is feeling). The cognitive component represents the appraisal of another's emotional state (i.e. understanding what the other person is feeling). Successful human social interactions depend in part on our ability to empathize with others. Those with deficits in empathy can appear cold and distant, and their social relationships suffer as a result (Watt, 2005). Notably, humans possess empathic-like responses from early in life. For example, newborns will cry more and show facial expressions of distress for longer when hearing recordings of other newborns crying, than their own cries (Dondi, Simion, & Caltran, 1999). This ability to recognize others' emotions continues to develop throughout our lifespan and is a cornerstone of our capacity to respond to others in appropriate ways (Ickes, 1993).

A critical component to empathic accuracy, and a fundamental part of social interaction, is our ability to reliably identify facial expressions (Ekman & Friesen, 1971). For empathy to function in social situations it requires the knowledge of discrete emotions, which is how humans respond quickly and correctly to the emotional experience of others (Decety & Jackson, 2006; Hoffman, 2001; Izard, 2007). Facial expression recognition and empathy seem to be inextricably linked within the brain. Studies on facial recognition find that presenting static facial expressions of emotions results in the activation of empathy related neural structures (Prochnow, Höing, et al., 2013; Seitz et al., 2008), even in short (subliminal) presentations of expressions (Prochnow, Kossack, et al., 2013). Individual differences in empathy are related to how people respond to emotional stimuli, such as the accurate recognition of facial expressions, and reading emotional states from the eyes (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Besel & Yuille, 2010).

As with facial expression recognition, one might hypothesize that differences in empathy might be of relevance to detecting deception, as liars and truth-tellers display different emotions, especially in the face (Ekman, 2003a). However, there has been no conclusive evidence linking empathy with deception detection (Hill & Craig, 2004). Additionally, there seem to be significant gender differences, once more favouring women. Women display higher empathy, both cognitive and emotional (Mestre, Samper, Frías, & Tur, 2009), however, no relationship between empathy, gender, and accuracy have been found. Furthermore, while empathy has been linked to improvements in detecting specific microexpressions, such as anger, overall it does not seem to aid their detection (Svetieva & Frank, 2016). Conversely, while not explored in this thesis, empathy may relate to the liar's ability to deceive, as people higher on empathy can imitate facial expressions better, which may serve their ability to produce deceptive facial expressions (Williams, Nicolson, Clephan, Grauw, & Perrett, 2013).

**Summary: Emotions**

Understanding how people perceive and process emotions is highly relevant to understanding the diagnostic usefulness of emotional cues for deception detection, and the impact they have on the veracity judgement process. The emotion-based approach has been criticised for not providing improvements in accuracy, and thus has lost the interest of the field. I propose that emotions are relevant to how people decode deception, and the seeming contradictions and mixed findings of this research can be resolved. This thesis will explore the role emotions have on the process of deception detection, providing new information regarding this relationship, and suggest a theoretical framework through which to better understand how people decode facial expressions and why they impact accuracy.

# Chapter 4: Multi-Decoder Deception Detection – Exploring Errors in Veracity Judgements


## Abstract

In this chapter I investigated the decision-making process of decoders, attempting to understand their ability to perceive the veracity of others, how this is influenced by whether decoders judged deception alone or in pairs, and by controlling the type of justification (i.e. response type) required before their decisions. Understanding if the failure to detect deception is attributable to the inability of one decoder to perceive all the relevant information (i.e. behavioural cues) is important in constructing a model of how decision making under situations of uncertainty are made.

People make judgments about deception differently when working alone or in pairs. One possible reason for this difference is that collaboration requires people to verbalise and justify their judgements, and that this deeper processing changes the decision-making process. This explanation was tested by controlling the amount of information that participants communicated, while detecting deception alone or in a pair. Participants provided a binary truth/lie decision, a binary decision and a reason chosen from a list, or an open ended explanation of their decision. It was found that both factors—group size and the amount of information communicated—had effects on participants' accuracy, bias, and confidence. Participants' ability to detect deception when working together is influenced by the increased processing demands of communication and the social interaction itself.

## Introduction

People's ability to detect deception is just above chance level (Bond & DePaulo, 2006), additionally, they tend to be bad at detecting deception in a very particular way: they are biased towards assuming others are being honest, leading to an overestimation of truths and an underestimation of lies (Levine et al., 1999). In the laboratory, the focus is almost exclusive on an individual and the psychological processes they follow when judging honesty. But outside the laboratory, such judgements are often made collectively. Police interrogations are regularly carried out by multiple officers, as are juries which require the unanimous decision of a group when deciding the guilt or innocence of the accused (Inbau, Reid, Buckley, & Jayne, 2011). In simple perceptual decisions, it has been shown that two people can combine their knowledge and uncertainty in near optimal ways (Bahrami et al., 2010). These types of scenarios raise very important questions: is accuracy improved when multiple decoders share their views and collaborate while making veracity judgements? Or conversely, as the work on 'group think' has shown (Janis, 1972), do groups of people become more biased and less accurate when they make a decision together? These questions are at the heart of the deception literature, as many have argued that accuracy is low due to either the inability of a decoder to perceive the relevant information, or the biases they have interfering with the judgement process.

Multiple decoders are believed to have an advantage in determining veracity, as the diversity and amount of knowledge that each individual possess can improve group performance (Jehn, Northcraft, & Neale, 1999). It is more likely that if multiple decoders watch the same situation one may uncover the specific piece of information that will allow for a clear classification of veracity (e.g., Hoffman & Maier, 1961; Jehn & Bezrukova, 2004). Individuals working together are presumed to engage in more systematic and analytical thinking, which may result in better veracity judgements (Park et al., 2002). This may also decrease the amount of judgemental bias, as people avoid using heuristics and intuition, which are difficult to articulate and justify to others (Frank et al., 2004).

Performance of multiple decoders on a task is suggested to also relate to their ability to accurately communicate each member's level of confidence regarding a decision in a manner that all can understand. Members must align their metric for gauging confidence by using a common language (Fusaroli et al., 2012). If this is achieved in a situation where veracity decision must be made it may produce an increase in accuracy, as the group would use the most confident member's answer to determine veracity (cf. DePaulo et al., 1997). In such scenarios, it can be argued that multiple decoders will outperform individuals in judging veracity.

However, it is also possible accuracy may decrease as a result of working in a pair. As I have discussed, laypersons knowledge of cues relating to deception is inaccurate and unrelated to actual empirically proven cues (DePaulo et al., 2003; Vrij, 2008). In group situations such information may spread amongst members leading to a pooling of bad information (Park et al., 2002), decreasing accuracy and increasing bias. Similarly, while a more analytical review of information from senders may improve accuracy, it also implies that decoders are less likely to base their judgements on hunches or intuition (Feeley & Young, 2000; Hurd & Noller, 1988). The research on unconscious lie detection suggests that indirect judgements made based on such intuitions are fairly accurate (Granhag, 2006; ten Brinke, Stimson, & Carney, 2014; cf. Franz & von Luxburg, 2015; Levine & Bond, 2014; Moi & Shanks, 2015). In groups, not using hunches and intuition may lead to less unconscious deception detection, and worse accuracy.

Working with others can also increase the likelihood of groupthink mentality and social loafing. Groupthink is the tendency of members to discount or ignore their own opinions in favour of that of the group in order to maintain group cohesion. Research has shown that failure to allow members the option to voice their own interpretation of the evidence privately can result in worse decision making by the group (Baron, 2005; Turner & Pratkanis, 1998). Social loafing is the tendency of individuals to exert less effort on a task if they are in the presence of others. Multiple decoders can perform worse overall than would the sum of the individuals acting alone, as members put in less effort on detecting deception (Karau & Williams, 1993; Latane, Williams, & Harkins, 1979). These scenarios illustrate how multiple decoders can potentially have decreased performance when attempting to detect deceit, compared to their performance working alone.

Small groups' research may shed some light on the potential effects present in multi-decoder scenarios. There, the mere presence of another person in a situation has been found to increase drive, and motivate people to perform (Zajonc, 1965). There is evidence to suggest that working in pairs results in improved performance compared to individuals, by pooling individual confidence (perceived uncertainty) in an optimal manner (Bahrami et al., 2010). For example, groups are over twice as fast on perception tasks (Brennan, Chen, Dickinson, Neider, & Zelinsky, 2008) and can outperform individuals on problem solving tasks (e.g., Bornstein, Kugler, & Ziegelmeyer, 2004). Findings suggests that even if participants have diverse knowledge on a topic that could improve task performance, it is only when they can communicate their confidence to each other, allowing the most confident member to make the final decision, that a benefit is observed (Hirokawa, Ebert, & Hurst, 1996); if multiple members share their intuition, it can convince them to make a decision that individually they may have discounted (Burgoon, Buller, Dillman, & Walther, 1995).

However, not all research is as positive in terms of group performance. Studies also find that groups rarely outperform individuals, or their best member on item such as general knowledge, or jury settings (e.g., Hastie & Kameda, 2005; Kerr & Tindale, 2004; Tindale, 1989). The higher confidence that groups generally experience, compared to individuals alone, can impact the way information is processed. It leads groups to make faster decisions using only limited information (Levine & McCornack, 1992), which can result in poorer performance. Groups also tend to use superficial evidence, such as demeanour, when making decisions, while discounting content information than may prove more valid to judgements (Colwell, Miller, Lyons, & Miller, 2006).

The few studies that have looked at multi-decoder deception detection report inconsistent results in terms of the judgements of groups compared to individuals, and focus very little on the underlying mechanisms of such differences.

One such study by Park et al (2002) investigated differences in veracity judgements of groups of between three and six individuals compared to judgements made alone. Participants watched 16 clips from two senders regarding answers to a Machiavellian questionnaire, where the senders were asked to lie on half of the questions. In the group condition participants were allowed to discuss their opinions regarding the videos before providing a final veracity decision. Participants were also asked to provide confidence ratings for their decisions, and specify a behaviour from a list that assisted in their decision. They found that groups were not more accurate than individuals in judging veracity. All participants were also more biased towards answering that the statements they heard were truthful rather than deceptive (i.e. truth-biased). Finally, even though their accuracy was not higher, groups were more confident in their answers regarding veracity than individuals.

A limitation of their study was that participants in the group condition were restricted to only providing a joint decision, but not a private one. This increases the likelihood of a groupthink mentality (Raafat, Chater, & Frith, 2009; Turner & Pratkanis, 1998). The use of only two senders for the stimuli is also a limitation. If these particular senders happened to be either excellent or poor deceivers the results would be skewed, not allowing for an accurate measure of judgemental accuracy.

Frank et al (2004) built on these findings by having individuals making veracity decisions either alone or in groups of five, while also making a few alterations to the design of Park et al.. They used high-stakes lies and added the option of decoders to stay their judgement (i.e. hung decision). Contrary to Park et al. they reported that groups outperformed individuals on lie detection, but not truth detection. They attributed this effect to the increased use of the hung decision by groups for what they considered difficult videos. In line with past research they found that groups were more confident in their decisions—

individuals showed lower confidence at the end of the experiment, while groups had a constant level—but this did not correlate with accuracy (see DePaulo et al., 1997; DeTurck & Miller, 1990). They attributed this result to the *illusion of productivity-and-efficiency* effect, whereby simply working with others makes members of the group believe they are working harder and better, when in fact no change is occurring (Paulus, Dzindolet, Poletes, & Camacho, 1993; Sniezek, 1992; Sniezek & Henry, 1989). Their results also found that groups were more lie-biased.

A more recent study by McHaney, George, and Gupta (2015) investigated differences in detecting naturalistic, unsanctioned lies between individuals, ad hoc groups, and established groups, suggesting that accuracy can only be improved if the group members have a prior relationship. They reported that groups outperformed individuals in detecting deception; unlike Frank et al, here truths were detected more accurately by groups, not lies. The authors suggest this improved accuracy (especially that of established groups) is due to the relationship between members of a groups allowing for better communication and decision-making. However, both group conditions received interactive training before the start of the experiment, which even the authors suggest may have acted as training that could have indirectly improved accuracy later on (e.g., Hauch et al., 2014), leading to an artificial increase in performance.

Similarly, a study by Klein and Epley (2015) investigated group versus individual accuracy when detecting both low- and high-stakes lies. On four separate occasions groups outperformed individuals. The authors attributed this group advantage to the process of group discussion, discounting the *wisdom-of-crowds* effect or differences in response bias. However, when they investigated the "best decoder" in each group compared to group performance, they found no significant differences. The authors argue that as these best decoders were identified post hoc that they might simply be the ones that benefited the most from the group discussion process. However, as no information on the deliberation process was presented, it is hard to argue for an effect of group discussion on accuracy. While the authors claim bias was unaffected by working in groups, their results show that having members make an individual judgement first resulted in more "truth" decisions, while less so when making a group decision first. This result reflects the suggestion by Frank and colleagues that members of groups rely less on hunches and may be more inclined to 'spot the liar', reducing the truth-bias.

Importantly, all the above studies used groups of decoders, which adds variability and noise to the data, as well as producing different dynamics (e.g., gender diversity and distribution effects; Zhou, Sung, & Zhang, 2013). The authors in the above studies commented that it is difficult to uncover the exact reason(s) for the effects they presented due to the potential psychological, social, and cognitive interplay between group members. For example, groups have a higher likelihood that one member is adept at detecting lies (i.e. higher variability) compared to recording judgements made alone, but this is unrelated to any group dynamics influencing the judgement process. The use of dyads might provide a clearer effect of multiple decoders, reducing the influence of conformity, majority rule, groupthink, and other demand characteristics of specific designs.

Of more relevance to the current chapter, focusing on pairs only, Culhane, Kehn, Hatz and Hildebrand (2015) looked specifically at deception detection comparing individuals with dyads, eliminating the difficulty in examining group dynamics. They considered multiple types of lies—real and mock transgressions—and presentation modality—audio or audio-video. They found that dyads were no more accurate at detecting deception than individuals. No interaction with type of lie or modality was found. Their study illustrates that even if others find groups might show a slight improvement in accuracy dyads do not.

The current literature on multi-decoder deception detection presents a conflicting collection of results, and little insight into the mechanisms that may be responsible. For example, the increase in confidence decoders have may be due to members of the group sharing information, even if incorrect or useless, making them believe they are being productive (e.g., Frank et al., 2004). However, it is just as likely that the mere presence of others makes one more confident. This can also be applied to the effect of bias. The fact that in Frank et al. the groups were more likely to use the hung decision may reflect that people are more analytical when working in groups and rely less on heuristics, leading to more lie judgements (e.g., Park et al., 2002). Conversely, multiple decoders in the room with the main goal of 'spotting' a liar may result in an increase in suspiciousness, leading to a reversal of the truth-bias without the need for communication (Buller, Strzyzewski, & Comstock, 1991; Hilton, Fein, & Miller, 1993; Stiff et al., 1992).

***Present Study.*** To understand the effects that are observed when individuals make judgements of veracity together, a more detailed approach must be used. The current study aimed to provide further insight into these judgmental differences by directly controlling the flow of information between individuals working together. I investigated the differences in accuracy, bias, and confidence between individual and pair veracity judgements.

The amount and type of information used by individuals before making a veracity decision was considered crucial for the way judgements are made by multiple decoders. This factor was manipulated by providing participants with three methods of deliberation before the final veracity decision was made: (i) a binary option were participants were allowed to provide only a 'truth' or 'lie' response when making their decisions, providing the bare minimum of interaction, (ii) a 'reason' option where they were allowed to also state a single reason from a predetermined list regarding the information they used to assist in making their decision, allowing members to both express and understand each other's opinions more clearly, (iii) a 'talk' option where they were allowed to openly discuss their process for reaching their decisions before providing their final judgement.

The current study used pairs instead of groups, as among the previously enumerated issues, past research suggests groups can find it difficult to keep its members actively engaged in the task (Marett & George, 2004). Pairs are more easily managed and require that both individuals are active in the task. This reduces the risk of groupthink as well as the possibility of social loafing, resulting in a more accurate representation of performance, and subsequent interpretation of effects.

It was predicted that a difference would be observed in the accuracy of deception detection between singles and pairs. Secondly, that members in pairs will show higher confidence in their decisions. Thirdly, that pairs may show a difference in the truth-bias, showing a reversal in its direction. Finally, that these effects will be influenced by the amount of information decoders can share with each other.

**Method**

***Design.*** A three-way mixed design was used. The independent variables were Group (Singles or Pairs) and Veracity (Lie or Truth) as between-subjects factors, while Level of Communication (Truth-Lie (T/L) vs. Reason vs. Talk) was the within-subjects factor. The dependent variables was the accuracy score and confidence rating in their decision.

***Participants.*** The experiment was conducted with 59 participants, 19 males and 40 females; $Mean_{Age}$ 21.89 ($SD$ = 6.53). There were 25 participants in the Singles condition (6m, 19f) and 34 participants in the Pairs condition (13m, 21f). Participants in the Pairs condition were paired for the experiment to form 17 pairs. All participants were recruited using the UCL's Sona Systems® Online Subject Pool, and received credit or £1.

***Materials.*** 18 videos (9 lie and 9 truth) from the Bloomsbury Deception Set (BDS; Street et al., 2011), consisting of individuals lying or telling the truth about a past vacation. Senders in the videos are describing past vacations, where half of the sample is lying (i.e. inventing a holiday). The set is considered to contain naturalistic lies, as the aim of the senders was to deceive the person recording the video, who was not told of the deception occurring, and the senders were not given any incentive to deceive other than being asked to help out with a travel documentary. The set contains two videos per sender, a fictional and a true vacation story (counterbalanced); for this set the order in which the lie was recorded initially was controlled, and no sender was used twice. The 18 videos were split into three equal sets, with 3 lies and 3 truths per set. These were also controlled for gender of sender, and order in which the lie was told. All videos are around 30s long.

A computer instant message chat client was used for the participants' interaction for the Pair-T/L and Pair-Reason conditions. This transmitted information regarding the veracity judgement and additional information of each member of the pair, so as to avoid direct interaction.

For the Reason condition, a list providing potential reasons for the veracity decision was also created. Options were: "1. The person's facial expressions", "2. The person's body movements", "3. The person's voice", "4. The way the person was speaking", "5. What the person said (content)", "6. I just have a hunch (intuition)", "7. I do not know (guessing)."

***Procedure.*** Participants were randomly placed in a group conditions, Singles or Pairs. At the start of the experiment all participants were asked to state their confidence in their ability to detect deception (pre-test confidence), using a 5-point scale ranging from "Very poor" to "Very good". Participants were placed in front of a computer screen on which instructions and the videos were presented. The procedure between singles and pairs was slightly different, but followed the same outline to attempt to reduce potential artificial differences in responding (see Figure 1).

There were 3 blocks of videos. In each block the way in which participants deliberated on their decision changed, but the final responses recorded were the same. Participants watched each video and made a veracity decision (forced choice: lie or truth) and stated the confidence in their answer, using a 5-point scale ranging from "Very unsure" to "Very sure". The three conditions were: Truth-Lie (T/L), Reason, and Talk. Participants sat in a cubicle in front of the computer alone or in pairs and followed the given instructions for each Level of Communication (LoC) condition until the experiment was over.

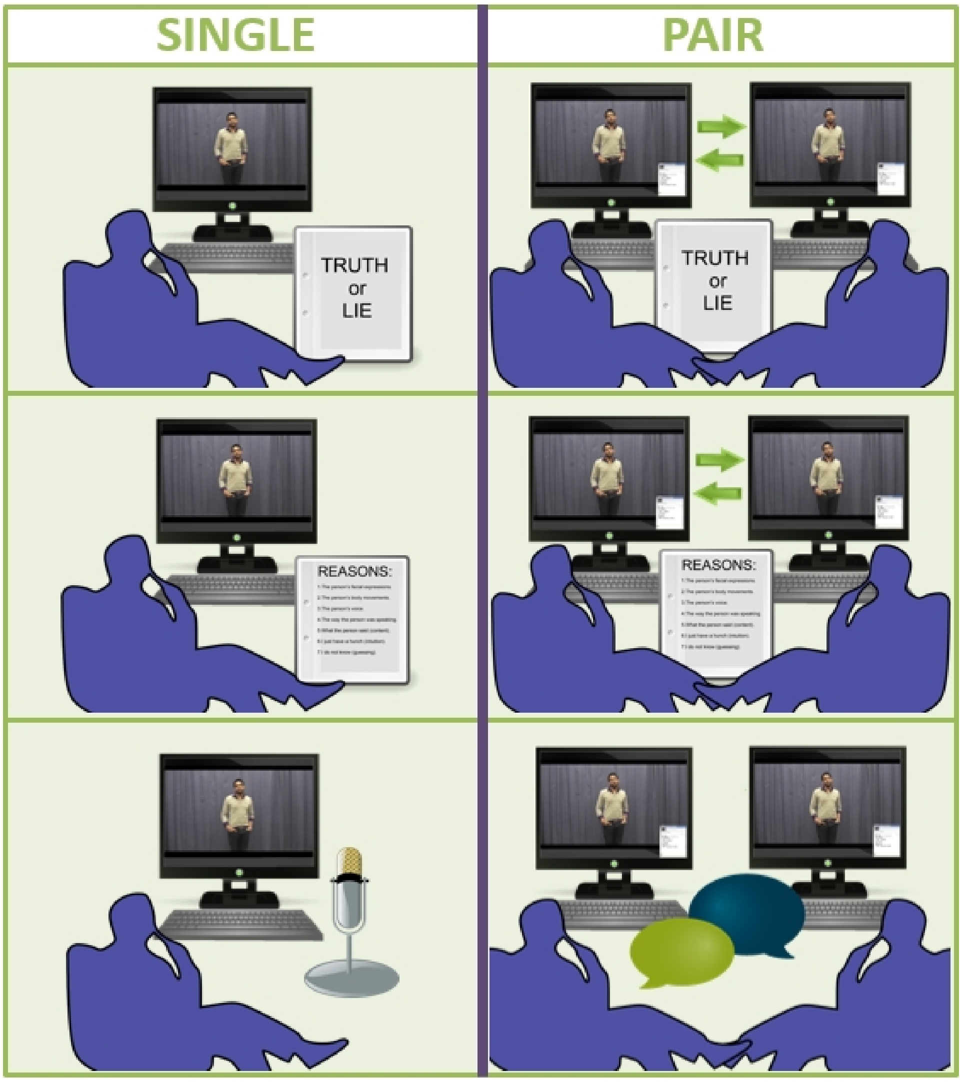


Figure 1. Experimental setup for Singles and Pairs. Each box represents a response condition. The top is the T/L condition, followed by the Reason and Talk condition.

The general procedure for the Singles condition was as follows: in the T/L condition, participants responded to the videos by simply stating if the sender in the video was lying or telling the truth, and providing a confidence rating for their decision. In the Reason condition after stating the veracity decision they also stated the reason for their response by selecting one item from the list provided. Lastly, in the Talk condition before the participant made their veracity decision they were allowed to talk freely into a digital recorder about the reasons for making their decision, for a maximum of 3 minutes. The order of these conditions was randomised between participants.

The general procedure for the Pairs was kept as similar as possible to that of Single participants, and was as follows: in the T/L condition, after watching each video, participants (P1 and P2) first stated their veracity decision privately on a response sheet, then using the chat client made their choice known to the other participant. If the two members were in agreement (e.g., "P1: Truth" and "P2: Truth") they proceeded, if not (e.g., "P1: Lie" and "P2: Truth") they were asked to attempt and reach a joint decision (the instruction was displayed on screen through the chat client by the experimenter). If no consensus could be reached (e.g., after reconsidering privately, the new veracity decisions of P1 and P2 still did not match) then one was randomly asked to change their response[1]. Finally, they privately rated their confidence in the joint decision.

For the Reason condition after watching each video participants initially stated the veracity decision and a reason for their decision from the list of options (e.g., "P1: Truth, 3"); this was then passed on to their partner. Again, a joint decision was required. Participants were asked to look at their partner's decision and reason, and either keep their answer or reconsider. The addition of the reason to the decision was used as a proxy for confidence or insight into the judgement; if P1 answered "Truth" but gave the reason "7"—guess—then the second participants would be more likely to either accept or reject their partner's decision if their own was based on a clearer reason. If they were able to match veracity (even if reason did not match) they would progress to the next video. In case of a mismatch of veracity decision (e.g.," P1: Truth, 3" and "P2: Lie, 3") a random forced decision was used. Again, a confidence rating for each joint decision was made privately by each participant.

For the Talk condition after each video participants made a private veracity decision, then shared their decision with each other verbally and had 3 minutes to discuss their answer

[1] In situations where a joint decision cannot be reached, the accuracy with which a forced joint decision is made is equivalent to a coin flip. In dyad studies, the use of a random choice to arbitrate between two parties is a common technique to allow for the continuation of a joint task (see Bahrami, et al., 2010).

until a joint decision was reached. If the two parties agreed on a response they were allowed to move to the next video. If no consensus was reached an answer was selected at random by the experimenter. Each participant then privately stated their confidence in the joint answer.

At the end of the experiment all participants answered a post-test confidence question regarding their ability to detect deception, and were debriefed.

**Results**

Overall deception detection accuracy for Singles was 49.8% and for Pairs was 49.1%. A comparison of mean accuracy between conditions for each veracity is illustrated in Figure 2.

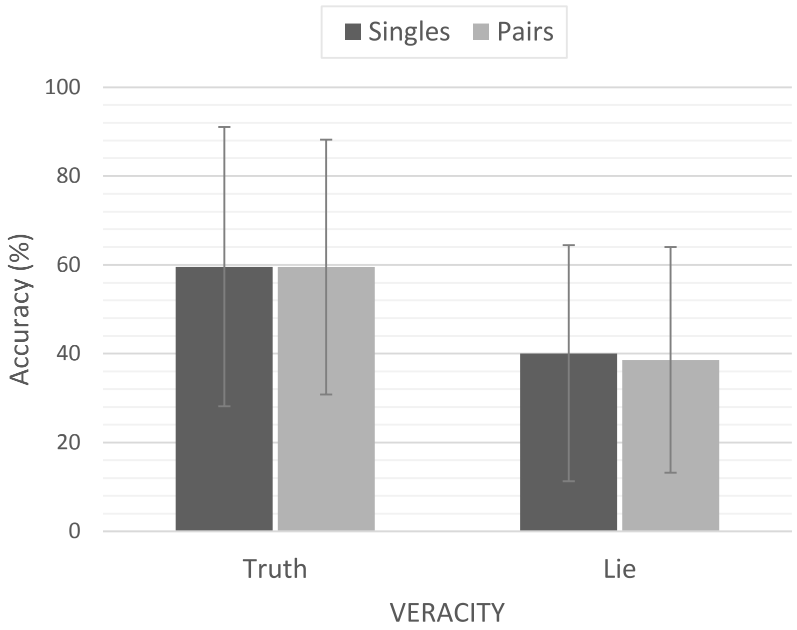


Figure 2. Means Accuracy Scores and Standard Deviations (error bars) for Singles and Pairs, split by veracity.

While the two groups contained unequal cell sizes, all analyses found that the difference between the two did not affect the results presented (i.e. Mauchly's sphericity tests were all non-significant).

***Deception Detection Accuracy.*** To investigate the effect of working alone or in a pair on deception detection accuracy an ANOVA was conducted looking at Singles and Pairs compared to the two veracities.

The results revealed a main effect of Accuracy, $F(1,40) = 27.35$, $p < .001$, $\eta_p^2 = .406$, favouring Truth detection ($M = 5.36$. $SD = 1.56$) over Lie detection ($M = 3.55$, $SD = 1.53$). However, no main effect of Group condition (i.e. Single vs Pairs) was found, $F < 1$, ns., nor an interaction between Accuracy X Group, $F < 1$, ns.

As past research has found that occasionally multiple decoders show differences in accuracy than single decoders, but, that this performance can be explained by the accuracy of the groups "best decoder", I investigated any differences in deception detection performance between the pairs' joint decision and that made by each dyad's "best detector". Surprisingly, the results reveal that Pairs ($M = 8.82$, $SD = 1.79$) produced a worse joint decision than if simply using their best decoder ($M = 10$, $SD = 1.46$), $t(30) = 2.54$, $p = .017$, 95% CI [.28, 2.61], $d = 0.93$.

***Confidence.*** An ANOVA was conducted to investigate the effect of working alone or in a pair on confidence in one's judgements. The results of each individual judgement was summed up to form an overall confidence score. As predicted, working in pairs ($M = 67.21$, $SD = 4.77$) resulted in a significant increase in confidence compared to working alone ($M = 61.48$, $SD = 7.01$), $F(1,40) = 8.61$, $p = .006$, $\eta_p^2 = .131$. The effect was observed for both Lie, $t(40) = 3.08$, $p = .004$, 95% CI [4.99, 1.03], $d = 0.97$, and Truth statements, $t(40) = 2.18$, $p = .035$, 95% CI [5.00, .19], $d = 0.69$. However, the pre- and post-confidence scores in one's ability to detect deception showed no significant change due to group condition, $F(2,80) = 1.71$, $p = .198$. This could suggest that a continuous confidence rating is a more sensitive measure of the effect that pairs have on veracity judgements.

***Bias.*** The veracity responses were coded as 1 for truth and -1 for lies, with 0 representing no bias. These values were summed for all videos to create a bias variable (range -18 – 18). The results indicated that Singles were more truth-biased ($M$ = 3.08, $SD$ = 4.65) than Pairs ($M$ = 1.41, $SD$ = 4.55). However, the analysis revealed that this difference in response bias was not significant, $t(40) = 1.17$, $p = .249$, 95% CI [-1.21, 4.55], $d = 0.37$. Comparing the bias scores to no bias (0) revealed that Singles were significantly truth-biased, $t(24) = 3.31$, $p = .003$, 95% CI [1.16, 5.00], $d = 1.35$, while Pairs did not show any response bias, $t(16) = 1.34$, $p = .20$, 95% CI [-.82, 3.65], $d = 0.67$.

***Level of Communication.*** To investigate the primary hypothesis of the current experiment, and understand if the type of deliberation that participants used during their decision-making had an effect on their judgements, the analyses for accuracy, confidence, and bias were conducted for the three experimental conditions, T/L, Reason, and Talk.

*Accuracy.* A three-way factorial ANOVA was conducted to uncover any effects of Veracity (Truths vs. Lies), LoC (T/L, Reason, and Talk), and Group (Singles vs. Pairs) on accuracy. Considering Veracity with the LoC factor revealed no interaction effect, $F(2,80) = 1.71$, $p = .187$, nor a three-way interaction with Group, $F < 1$, ns. Analysing Lies and Truths accuracy by comparing each LoC did not find any significant interaction of LoC and Group on detecting deception, for either Lie, $F < 1$, ns., or Truth accuracy, $F < 1$, ns. (Figure 3).

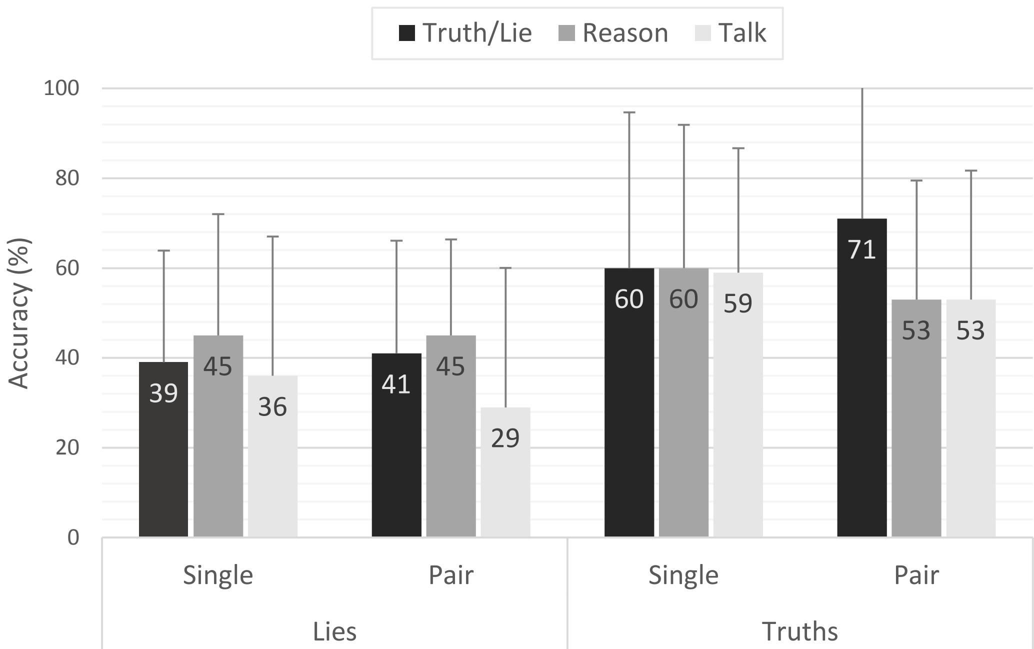

Figure 3. Mean Lie and Truth Accuracy Scores, split based on the Level of Communication conditions, and Single and Pair groups. The error bars represent ±1 Standard Deviation.

As the Group variable had no effect on accuracy, the subsequent analyses aggregate the accuracy scores from Singles and Pairs. Looking at accuracy across the LoC conditions uncovered a main effect on Lie detection, $F(2,80) = 3.23$, $p = .045$, $\eta_p^2 = .093$, but not Truth detection, $F(2,80) = 1.09$, $p = .342$, $\eta_p^2 = .018$. Unpacking the lie detection scores (t-tests, Bonferroni-corrected at $p = .0167$) revealed only a (marginally) significant effect between the Reason ($M = 1.36$, $SD = .85$) and Talk ($M = 1.00$, $SD = .63$) conditions, $t(41) = 2.42$, $p = .02$, 95% CI [.06, .66], $d = 0.75$.

Comparing Lie detection to chance accuracy (50%) reveals that overall, individuals in the T/L and Talk response conditions were below chance accuracy, $t(41) = -2.71$, $p =.01$, 95% CI [-.54, -.08], $d = 0.85$ and $t(41) = -5.19$, $p < .001$, 95% CI [-.69, -.31], $d = -1.62$, while the Reason condition showed no difference from chance $t(41) = -1.09$, $p = .283$, 95% CI [-.41, .12], $d = 0.34$ (Figure 3). Comparing Truth detection to chance accuracy reveals that the T/L condition was significantly better, $t(41) = 2.79$, $p = .008$, 95% CI [.12, .74], $d = 0.87$, while Reason and Talk were not, *p*s > .10. Although, this should be interpreted with caution as the bias analysis suggests the effect may be primarily caused by a truth-bias (Figure 5).

*Confidence.* To see if the amount of information that participants provided before making their veracity decisions influenced their confidence, the results were compared based on LoC. There was no main effect of LoC on confidence, $F < 1$, ns., there was a significant main effect of Group, $F(1,40) = 5.51$, $p = .006$, $\eta_p^2 = .177$, and a marginally significant interaction, $F(2,80) = 2.80$, $p = .067$, $\eta_p^2 = .067$. Planned comparisons (independent samples t-tests, Bonferroni-corrected at $p$=.0167) between Confidence and LoC revealed that confidence significantly differed between Singles and Pairs in the Reason, $t(40) = -3.64$, $p < .001$, 95% CI [-3.79, -1.08], $d = -1.15$, and Talk conditions, $t(40) = -2.73$, $p = .009$, 95% CI

[-4.53, -.68], *d* = -0.86, showing significantly higher confidence scores when working in a pair (see Figure 4). However, Pearson's correlations between Accuracy and Confidence scores at each LoC revealed no significant results.

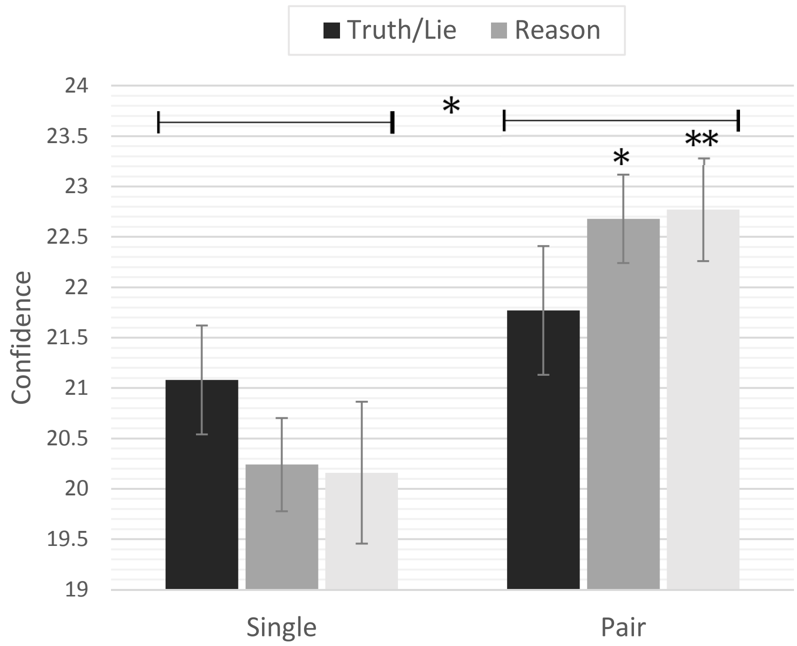


Figure 4. Confidence scores for Singles and Pairs, split based on the Level of Communication conditions. The lines over the bars represents main effect between Single and Pair groups. The asterisks over each bar represents a significant difference (one is $p < .05$, and two is $p < .001$) from the same condition in the opposite Group condition. The error bars represent ±1 Standard Error.

*Bias.* To investigate the effect that a multi-decoder scenario and type of deliberation may have had on response bias an ANOVA was conducted. It revealed that LoC had no main effect on bias, $F(1,40) = 1.37$, $p = .249$, or an interaction with Group, $F(1,40) = 1.69$, $p = .201$. To understand if response bias affect the innate tendency of decoders, the results were separated by Group and compared to a no-bias response. This revealed that Singles were truth biased in the Reason, $t(24) = 2,59$, $p = .016$, 95% CI [.23, 2.01], $d = 1.06$, and Talk conditions, $t(24) = 2,79$, $p = .010$, 95% CI [.29, 1.95], $d = 1.14$. This truth-bias was reduced in Pairs, as both the Reason and Talk conditions were not different from no-bias, *p*s > .50, and only a trend for a truth-bias was seen for the T/L condition, $t(16) = 2.28$, $p = .037$, 95% CI [.08, 2.27], $d = 0.93$ (Figure 5). However, as there were no significant differences between Group conditions these results must be interpreted with caution.

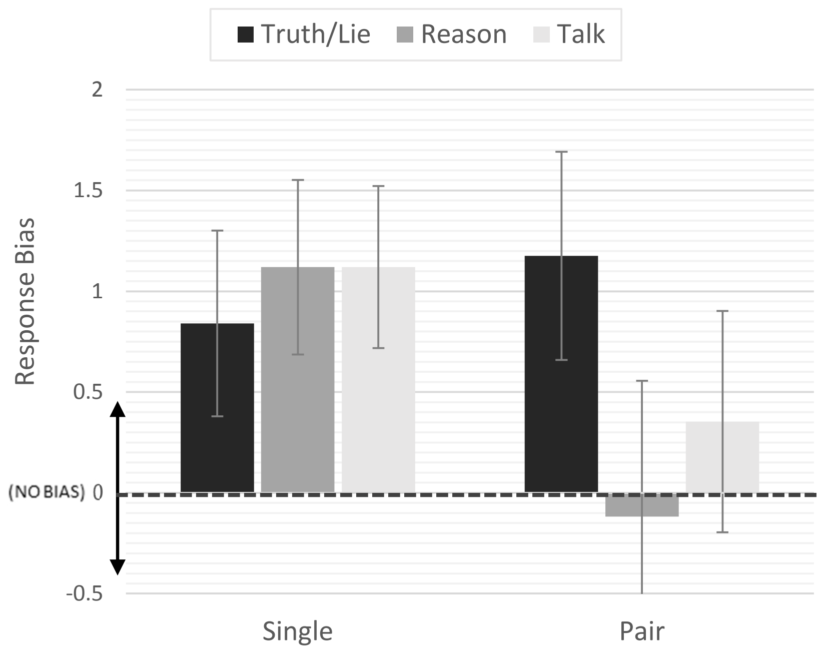


Figure 5. Response bias in veracity judgement for Singles and Pairs. The results are split based on the Level of Communication conditions. The dashed line indicates the no-bias level; all positive scores represent a truth-bias, while all negative a lie-bias.

**Discussion**

The experiment aimed to explore the way decoders make veracity judgements, and understand if some of the underlying assumptions of the deception literature, regarding accuracy and response bias, are present in multi-decoder scenarios. Past research has found that multiple decoders working together tend to be more confident than individuals, and make more lie judgements, but for accuracy the results are mixed (potentially dependent on group size). However, no study has investigated the potential mechanism creating these effects. Small-group research suggests that pairs may be more productive and show occasional improvements due to their ability to communicate their individual levels of confidence in a decision, leading to optimal decision-making. The present chapter set out to test if this improvement is observed in deception detection, where judgement are more complex and reliant on vague and/or limited information. To understand this in more detail, I manipulated the amount and type of information decoders communicated before making veracity decisions.

The predictions were that the decoders are unable to accurately and rationally make veracity judgments even when allowed to work with another. However, it was predicted that pairs would be more confident in these judgments. Also, pairs would show a potential shift in the truth-bias that decoders typically demonstrate, towards more lie judgements. Finally, it was predicted that the level of communication that decoders engage in while deliberating moderates these effects. Controlling the type of information separates the effect of mere presence (social component; T/L condition) with that of illusion-of-productivity-and-efficiency (dyadic pre-judgement discussions; Talk condition), and the effect of communicating confidence on the ability to make accurate judgements (Reason condition).

The results show that overall decoders were not very accurate at detecting naturalistic lies, and accuracy is not improved by working in pairs. The lack of multi-decoder impact was seen for both lie and truth accuracy, suggesting having multiple decoders focusing on the same sender, utilising their knowledge and perceptive skills does not provide any benefit in deducing veracity.

When considering the LoC, it was found that accuracy differed slightly based on the type of deliberation made. In Pairs, truths were detected at chance level, both when exchanging a specific reason (Reason) and conversing freely (Talk). However, restricting deliberation between members to only a binary decision (T/L) improved truth detection beyond chance level. This result may be explained by a more pronounced truth-bias in the T/L condition, similar to that observed when making judgements alone.

For lie detection the results showed no difference in accuracy between Singles and Pairs. When aggregating Group data, accuracy was affected by LoC, revealing that forcing decoders to provide a reason for their judgments improved detection compared to having them openly discuss their decision, or using a binary response. Furthermore, openly discussing the decisions led to the lowest lie detection rate. The fact that accuracy decreased in the Talk condition would suggest that decoders are making a veracity decision based on prior stereotypical (incorrect) information regarding cues, leading to reduced accuracy. Additionally, comparing lie detection to chance-level detection reveals that providing a binary decision or openly discussing answers results in decreased performance. This would imply that pre-judgement discussions serve to reduce accuracy, as individuals rely on inaccurate information to justify their decisions. However, these effects seem to be mitigated if using a structured response format; using a clear reason for their decision improved (marginally) lie detection accuracy. It could be that the cues stated on the list gave participants greater motive to suspect senders were lying, reducing their truth-bias, and leading to more lie judgements. Indeed, result from the bias analysis indicate that, at least pairs, in the Reason condition showed a trend towards a lie-bias. This should not detract from the fact that overall accuracy in the Reason condition was not reduced compared to the Talk or T/L condition.

Group research has indicated performance only increases if confidence can be accurately communicated between decoders, and that using nonverbal methods of communication can lead to the most improvement (Bahrami et al., 2012). The list of cues in the Reason condition can be viewed as an indirect confidence scale, as participants could either pick a specific cue, a hunch, or say they did not know. These would allow their partners to judge how strongly the other trusted their decision, as well as having a clear 'language' to communicate. However, a difference between groups and deception detection research is that in the former confidence can reflect the fact that one member possesses the correct information (as is usually the case in such paradigms), while in the latter the correct answer is not easily available to either member. This implies that confidence sharing is not beneficial in judgements regarding imperfect knowledge by all parties (i.e. most real-world scenarios). This is further supported by the “best decoder” analysis demonstrating that the joint decisions made by pairs was worse than if they would have identified their strongest member. This is important as it illustrates how (1) even when talking freely participants could not identify which one was the better decoder, and (2) that even if one member is superior they do not take over the decision making process.

With respect to judgemental confidence, decoders working in pairs showed a significant increase in all judgements. Indeed, the simple act of being paired with another made them perceive their performance as better, regardless of actual accuracy, suggesting that they may have been subjected to the illusion of productivity-and-efficiency effect (Frank et al., 2004). The amount of information that participants used at deliberation revealed additional differences between singles and pairs, which might explain the confidence effect. In pairs the T/L condition did not show the same confidence increase as the Reason or Talk conditions. This supports the prediction that interacting is necessary for confidence to be increased, implying that the mere presence of another person may not be sufficient, and that the act of sharing information is responsible for producing the confidence increase. In line with past findings, this increase in accuracy was not correlated with an increase in accuracy (DePaulo et al., 1997).

The implications of these findings are that individuals in legal and law enforcement settings may not benefit from discussing openly the reasoning behind a decision with their colleagues as it can result in feeling highly confident with a decision that may still be erroneous. This would be highly relevant in jury settings where members are typically instructed to discuss the evidence presented to them in order to reach a verdict. A more objective pooling of decisions may be more beneficial, such as providing private judgements beforehand, and telling individuals to provide evidence for their answers before sharing their opinions with other members.

Lastly, the experiment was also interested in the effect that the information provided before making a decision might have had on judgemental bias. The results do not find that bias was affected by working in pairs, although a trend towards a reversal in the truth-bias was observed. The analyses comparing the three response conditions with either working alone or in pairs also did not find any significant differences, suggesting that bias is not directly influenced by the amount or type of information considered at deliberation. Comparing responses to being unbiased revealed that singles, in almost all response conditions, were truth-biased in their responses, while pairs experienced a reduction in the truth-bias, with both the Reason and Talk conditions showing no bias. The evidence suggests that having decoders provide more than a binary response in a multi-decoder setting influences their response bias.

These results illustrate the importance of considering how the type of information can influence judgement when working with others. The mere presence of another individual was not enough to make judgement less truth-biased, but providing a reason or having an open discussion led to the decrease. While this was not related to an increase in accuracy per se, it also did not reduce accuracy, suggesting that allowing decoders to express their views may reduce their innate biases without negatively impacting accuracy. This finding reflects the suggestion that individuals working in groups tend to be more analytical towards veracity decisions (Levine et al., 1999). While it is difficult to conclude from the data if the effect on bias is due to more scrutiny of the senders or an increase in suspiciousness brought about by the experimental setting, it does offer interesting suggestions on how individuals in the security domain handle interrogations, proposing that stricter guidelines are beneficial.

Combining the results from the above analyses may allow for the creation of better interrogation methods, as well as more accurate jury deliberations. Taken together, the optimal method for multiple decoders to assess veracity may be through the use of a structured response format, where all members involved use a strict criteria to justify their opinions. The criteria must provide both empirically tested cues of deception and a method through which confidence can be easily and effectively communicated by all members. This method could eliminate the innate bias that individuals tend to have when judging veracity, and limit the artificial increase in confidence that is experienced when working with others.

A similar recommendation is using dyads with a pre-existing (beneficial) relationship. Small-groups research suggests that performance gains are observed when the communication between members becomes more synchronous (e.g., Bahrami et al., 2012; McHaney et al., 2015), or receive training in interactivity (Salas, Nichols, & Driskell, 2007). Using close partners may reduce the time taken for such synchrony to occur resulting in better knowledge-share and articulation of opinions. This would also remove inconsistencies in the data from a mismatch in pair members (e.g., McHaney, et al., 2015).

***Conclusion.*** The current experimental chapter attempted to tackle the issue of how decoders, working alone or in pairs, make veracity decisions; investigating how multi-decoder judgments influence accuracy, confidence, and bias. It would seem that accuracy is not influenced by either the type of deliberation used when making veracity judgements or by working in pairs. This suggests that decoders may not be able to perceive the necessary information to make rational judgements, or are unable to share any relevant information they possess to improve their performance, even when a superior decoder is present (showing little insight into their own performance). However, the use of specific cues or reasons for one's decision can lead to improved lie detection. Confidence, on the other hand, seems to be directly related to working with another, and increases with more complex interactions between members. While bias was not affected by either dyads or level of communication the results do suggest that working in a pair reduces the truth-bias, especially when forced to justify individual decisions. These findings provide novel insight into the way information affects veracity decisions, and suggests that regardless of method of deliberation or being allowed to collaborate on judgements, deception detection remains poor.

# Chapter 5: Emotion Recognition and Veracity Judgements


## Abstract

Emotional cues displayed by deceivers are presumed to be valuable to detecting deception. However, their usefulness as diagnostic cues has produced inconsistent results. I investigated two theoretical reasons for these inconsistencies. Firstly, the ability to read emotional cues from the deceiver varies between decoders. Secondly, emotional cue production is influenced by the stakes surrounding the lie. In Experiment 2, I explored the role of emotion recognition in the process of detecting everyday lies. Contrary to the literature, it was predicted that emotion recognition hinders the detection process, as decoders who rely on emotional information are less critical of message veracity. Decoders' accuracy was compared with their trait empathy and their ability to recognise micro- and subtle expressions. Results reveal that facial cue recognition is not related to accuracy, while trait empathy has a negative relationship with performance. In Experiment 3, I experiment-tally manipulated both emotion recognition ability and stakes surrounding the lie, presenting videos of deceivers in high- and low-stakes scenarios to decoders who had training in emotion recognition, no training, or received bogus training. The results showed that in all deception scenarios training did not improve accuracy, and that overall low-stakes lies and high-stakes emotional lies were easier to detect. The results build towards an understanding of how emotion recognition affects decoder veracity judgements and for detecting deception, arguing that emotion recognition is detrimental to veracity judgements, as it related more with aiding communication than accurate discrimination of affective cues.

## Introduction

Deception is considered a prevalent and necessary component of social interaction (DePaulo et al., 1996; Ekman, 1999; Knapp, 2006; McCornack & Parks, 1986), however, it is surprisingly difficult to detect (Bond & DePaulo, 2006). While not fully understood why accuracy is so low, three issues are given the most attention in the literature: (1) the lack of diagnostic cues to deception (DePaulo et al., 2003), (2) people's incorrect knowledge of authentic cues (Vrij, 2008), and (3) people's reliance on heuristics, biasing their decisions (e.g., truth-bias; Levine et al., 1999).

The purpose of the current chapter is to understand if the principles and theoretical assumptions that govern the emotion-based deception detection literature are a valid reflection of how decoders make veracity judgements. An assumption of the emotion-based approach is that an individual's ability to recognise emotional cues is a relevant component of the deception detection process. That is, the more perceptive and knowledgeable a decoder is regarding the emotional cues displayed by liars the more accurately they will be at uncovering their lies.

This assumption is tested over two experiments, by comparing decoders on their emotion recognition ability—perceiving and correctly interpreting emotional cues from others—with their ability to accurately detect deception. Contrary to the prevalent assumption regarding emotion recognition and deception detection accuracy (i.e. a beneficial one), I propose, and will demonstrate, that emotion recognition has little impact on correctly detecting deception, and can even produce a detrimental effect.

***Emotions and Deception.*** An assumption of the emotion-based approach to deception is that there exist universal differences between liars and truth-tellers related to the emotions that they exhibit physically. This approach posits that when lying individuals 'leak' subtle nonverbal cues which betray the lie. The inhibition hypothesis, suggests that this leakage occurs due to the underlying emotions associated with the lie being too overwhelmming to successfully mask or supress (Ekman, 2003a), producing a discrepancy between the emotions the liar feels and those they should be expressing (ten Brinke & Porter, 2012).

The strongest source of such diagnostic emotional cues are facial expressions (Ekman, 2003a), as individuals seem unable to exert full control over their production (Hurley & Frank, 2011), leaking genuine affect which can betray them (Porter & ten Brinke, 2008). While the use of emotional cues to classify veracity has not been fully explored, a few studies have shown lies and truths can be classified with high rates relying mainly on brief facial expressions (Ekman et al., 1991; Frank & Ekman, 1997; Porter et al., 2012). An often overlooked aspect of facial expressions is that they are also under (partial) deliberate control, and are used voluntarily for communication (Mandal & Ambady, 2004). Therefore, it is reasonable to assume they would also be used to deceive others. Liars can fake emotional expressions in the absence of affect to support their lies, mask their genuine affect, or neutralise their expressions to show no affect (Ekman & Friesen, 1982).

Considering this fact, I believe that a more comprehensive definition for emotional cues is required. Throughout this thesis I will separate emotional cues based on their underlying authenticity, allowing for a better understanding of behavioural information in deceptive scenarios, as well as explain some of the reported inconsistencies in the emotion-based literature. To this effect I separate emotional cues into *genuine cues* and *deceptive cues*. This definition is relevant as it demonstrates the existence of multiple emotional cues available for decoding affect, each having a theoretical different impact on accuracy (see Zloteanu, 2015). Under the category of genuine cues fall any emotional displays that reflects the true affective state of the sender. These are sub-divided into two types: *truthful cues* and *leakage cues*. I define truthful cues as cues derived from experiencing genuine emotions that naturally accompany honest communication (e.g., smiling when talking to a friend). While leakage cues are involuntary, spontaneous cues reflecting genuine emotions which the sender does not want to display, but is unable to suppress (e.g., leaking disgust while pretending to enjoy a horrible meal). The opposite category refers to deceptive cues, which are voluntary insincere emotional cues portrayed by a deceiver in order to create a false perception in the receiver (e.g., feigning compassion). These are sub-divided into *fabricated cues*, emotional displays which bare no underlying affect but are meant to signal a deceptive emotional state to a receiver, and *removed cues*, which reflect neutralised emotional displays, as to not allow a receiver information regarding one's own underlying affect.

In a recent publication regarding such a separation in terms, I proposed a model of emotional cue production during deceptive and truthful scenarios aimed to illustrate that the presence/absence of both genuine and deceptive cues is predicated on veracity and the type of lie told (Zloteanu, 2015). An updated illustration of this relationship is seen in the figure below (Figure 6).

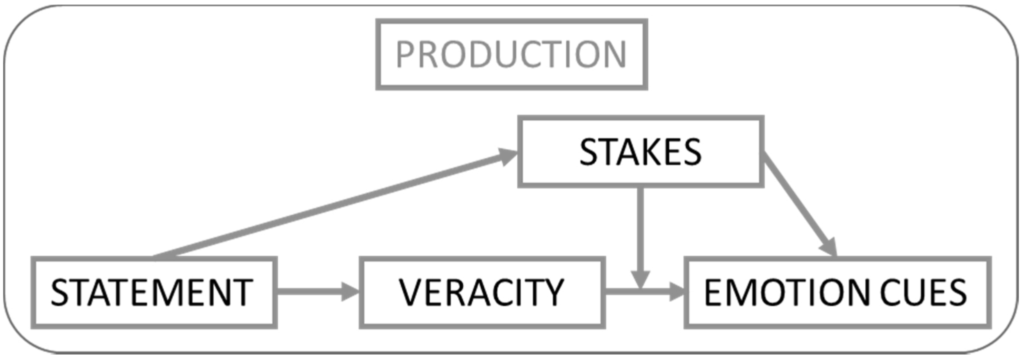


Figure 6. The role of Stakes and Veracity on Emotion Cue production (deceptive and genuine). Stakes acts as a mediator and moderator for deceptive and genuine cue production, while Veracity acts as a moderator for the relationship between the statement made and the emotion cues produced.

The model proposes that in low-stakes scenarios the lack of cognitive and affective changes when deceiving (DePaulo et al., 1988) results in fewer and less intense leakage cues (Frank & Feeley, 2003; Hartwig & Bond, 2011; Porter & ten Brinke, 2010; Porter et al., 2012). Furthermore, the lack of emotional intensity in everyday interactions decreases truthful cues when being honest (e.g., talking about the weather). While for deceptive cues, the lack of cognitive and affective interference allows liars to be more in-control of their behavioural channels (e.g., removed cues), and allows them to produce more deceptive cues (i.e. more fabricated cues) to support their deception (see DePaulo et al., 1988). In high-stakes scenarios, due to the increased arousal and cognitive load experienced during deception, liars are more likely to display leakage cues, while truth-tellers will display more truthful cues as a result of the emotional intensity accompanying such a scenario (e.g., recounting the death of a loved one). Additionally, liars are less likely to successfully neutralise their affective displays (i.e. less removed cues), and will find it more difficult to portray emotional displays voluntarily (i.e. less fabricated cues). This interpretation of behavioural cue production is useful for separating the inconsistent findings in the emotion-based research, especially regarding perception and veracity judgements.

***Emotion Recognition.*** To separate such a distinction on the decision-making processes of decoders, two components of the emotion recognition construct were considered: facial cue recognition—the accuracy with which people classify facial expressions of emotion—and empathy—the ability to accurately perceive and interpret the emotions of others. For cue recognition, two forms of facial expressions proposed by the emotion-based research as relevant to detecting deception were examined: microexpressions and subtle expressions.

Microexpressions are full-faced expressions occurring at around 1/5th of a second (Ekman & O'Sullivan, 2006; Yan et al., 2013), resulting from failed attempts to mask or suppress one's emotions (Ekman, 2003a). These have been found in many deceptive scenarios, in the laboratory (Ekman & Friesen, 1969; Ekman et al., 1991; Frank & Ekman, 1997, 2004) and the real world (Porter & ten Brinke, 2008, 2010). Although untrained observers seem unable to use microexpressions to overtly differentiate veracity (e.g., Ekman & Friesen, 1974), in specific scenarios, individual differences in detecting them has shown positive correlations with deception detection, such as emotional lies (Ekman & O'Sullivan, 1991; Warren et al., 2009) and mock crimes (Frank & Ekman, 1997). However, in the real world such "pure" and intense expressions of an emotion are rare (Izard, 1971; ten Brinke &

Porter, 2012), last longer than 1/5th of a second, and appear as partial expressions (Porter et al., 2012).

Subtle expressions are partial affective displays resulting from attempts to suppress or mask emotions (Warren et al., 2009). Unlike microexpressions their presentation is longer in duration, making them easier to perceive (Ekman, 2003a; Matsumoto & Hwang, 2011). Although, they can be more ambiguous due to only utilizing part of the normal facial musculature of prototypical expressions or displayed simultaneously with other emotions. While few studies have researched subtle expressions, evidence suggests that their recognition facilitates detecting emotional lies (e.g., Matsumoto, Hwang, Skinner, & Frank, 2014; Warren et al., 2009).

Taken overall, this research would suggest that, at least in certain scenarios, decoders that are better at reading facial expressions can fare better at detecting deception (Ekman & O'Sullivan, 1991; Frank & Ekman, 1997). This perspective lies at the core of the majority of investigations into using emotions as a diagnostic source of deception detection.

In the first experiment I will address the issue of emotion recognition ability and veracity judgements, arguing that poor performance is not a result of inability to perceive emotional cues correctly but due to an incorrect perception of such cues during veracity judgments. In the second experiment I directly manipulate the emotion recognition ability and extend the research to high-stakes lies.

**Experiment 2: Emotions, Empathy, and Low-Stakes Deception Detection**

An often overlooked aspect of deception research are the way people perceive and detect everyday lies, where the risks and rewards to the liar are low (e.g., insincere compliments, feigned interest, or faked positive emotions). Everyday lies tend to be predominantly about feelings, preferences, and opinions, serving the purpose of promoting social cohesion, reducing unnecessary tension and conflict (DePaulo et al., 1996; Lippard, 1988; Metts, 1989; Vrij, 2008).

The commonality of such lies makes understanding the way people might be able to detect them and utilise nonverbal information (e.g., emotional cues) to ascertain veracity an important matter. The literature does not make any strong claims as to how low-stakes lie detection may differ from their high-stakes counterparts beyond the assumption that they are more difficult to detect (DePaulo et al., 2003, 1988). While such minor lies might not be serious enough to warrant attention or detection in most scenarios, these account for a large part of daily social interactions (DePaulo et al., 1996; Hancock, 2007). Understanding how they differ from serious lies is important for our understanding of deception and veracity judgements, and should not be overlooked. Utilising such lies, if operationalised correctly, can provide valuable insight into how decoders make veracity judgements, especially regarding emotions.

Everyday lies do not make liars feel very anxious or afraid of being caught, as there are fewer risks or rewards involved (DePaulo et al., 1996), nor does generating them result in increased arousal or cognitive effort (McCornack, 1997; Vrij, 2000), which means liars do not experience any strong emotions, such as fear or guilt, from perpetrating the lie. The implication of this being that such lies should be harder to detect, as there will be fewer behavioural cues (especially relating to emotions) that decoders can utilise, and because liars may have more resources available to generate such lies (resulting in improved deceptive performance). The literature thus far poses the problem of detectability of everyday lies as one of a high signal-to-noise ratio (i.e. few cues that decoders can use). I believe this interpretation is only partially correct, and overlooks an important aspect of the detection process: how decoders utilise and interpret the emotional information in scenarios where diagnostic cues (e.g., leakage cues) are mostly absent.

The current experiment aimed to understand why facial cue recognition has been rarely found to aid deception detection and why decoders that are naturally more attuned to the affective states of others do not perform better at uncovering deceit. To do this I attempted to separate the emotional cue detection component of veracity judgements with the apparent judgemental interference that individual differences in emotion recognition have on veracity judgments. While in high-stakes scenarios the purported presence of leakage cues (during deception) and truthful cues (during honesty) should result in emotion recognition relating positively with accuracy (e.g., Frank & Ekman, 1997), in everyday scenarios genuine cues are absent or scarce, and there is an increased likelihood of deceptive cues being present, as liars are less distracted from their banal lies, allowing more control over their nonverbal channels, hindering deception detection (DePaulo et al., 1988). This scenarios is ideal for exploring the effects of emotion recognition on veracity judgements.

Facial cue recognition is not the only component of emotion recognition which can be relevant to ascertaining the veracity of another. Empathy is considered a necessary component of social communication, especially in predicting the behaviour of others (Keysers, 2012), and influences the accurate identification of emotional cues (Bugental, Shennum, Frank, & Ekman, 2001; Ekman & O'Sullivan, 1991; Etcoff, Ekman, Magee, & Frank, 2000). For example, empathy positively correlates with differences in facial expressions recognition (Besel & Yuille, 2010; Gery, Miljkovitch, Berthoz, & Soussignan, 2009) and detecting mismatched emotions (Wojciechowski, Stolarski, & Matthews, 2014); both important aspects of the assumptions underlying the emotion-based approach.

Empathy has a strong relationship with how emotions are perceived and interpreted in others. While the majority of research on empathy and facial recognition has focused on overt presentation of prototypical expressions, it has been found that even subliminally presented facial cues can activate the relevant neural structures underpinning empathic responses (Prochnow, Kossack, et al., 2013). Therefore, it can be argued that empathy should aid the detection of brief affective cues (such as microexpressions) and influence veracity judgements, even if they escape overt detection.

Similarly, empathy is related to the concept of facial mimicry, an important component of the emotion recognition system (for an overview, see Hess & Fischer, 2013). Facial mimicry refers to the automatic activation of the facial muscles corresponding to the emotional expression displayed by others (Dimberg, 1990). Relevant to the current research, facial mimicry has itself been linked to the accurate perception of genuine emotional cues (Maringer, Krumhuber, Fischer, & Niedenthal, 2011; Stel & van Knippenberg, 2008). As empathy relates to improved facial mimicry, and facial mimicry in turn aids recognition of genuine emotions (at least for smiles), it could provide a benefit in detecting genuine cues. However, during deceptive episodes the emotions displayed are disingenuous, and mimicry may serve only to activate these deceptive emotions in the receiver, resulting in poorer decoding of actual intent. That is, mimicry relates to understanding the emotions being *expressed* and not the emotions being *experienced* by another. Research on this topic has indeed found that supressing the mimicry response can lead to improved deception detection (Krumhuber, Likowski, & Weyers, 2014; Stel, van Dijk, & Olivier, 2009).

Empathy has two distinct components: cognitive and emotional (for a review, see Gonzalez-Liencres, Shamay-Tsoory, & Brüne, 2013). Cognitive empathy relates to the recognition of another person's emotional state, whereas emotional empathy relates to 'feeling' what another person is feeling (Reniers, Corcoran, Drake, Shryane, & Völlm, 2011). This distinction is potentially important for deception, as research using both genuine and deceptive facial expressions report that facial mimicry activates only the emotional empathy component of emotion processing, and not the cognitive (perspective-taking) component (Stel & Vonk, 2009). However, research on empathy's relationship with deception detection is scarce. Thus far, the research suggests that being more emotionally perceptive results in better cue classification, but not better classification of veracity. For example, the administration of oxytocin, a hormone used to enhance empathic accuracy (Bartz et al., 2010) results in a decrement in detecting deception (Israel, Hart, & Winter, 2014), as does higher emotional intelligence (a related construct) (Baker, ten Brinke, & Porter, 2013). This suggests that while one would expect being more perceptive of the emotional state of another would be beneficial to detecting veracity, it seems that individuals that are more attuned to such information not only do not show a benefit, they actually show lower performance.

The current reinterpretation of emotion recognition is that successful communication between individuals takes priority over attempting to uncover potential deception. Individuals tend to not suspect that deception is occurring if they are not prompted to do so, such as being made suspicious or put in a scenarios where deceiving is likely (e.g., police interrogation). With respect to emotional information, I predict that perceiving the emotions of another person will primarily focus on decoding the emotions at face value, ignoring the potential authenticity of such information. Emotion recognition ability, while related to interpreting and perceiving the emotional states of others, may be detrimental to detecting deception as it biases individuals into perceiving all emotional information as being genuine.

***Present Study.*** I propose that in everyday communication receivers are accurate at recognising emotional cues (as evidenced by the facial expression recognition research in Chapter 3), but this recognition corresponds only to the true emotions of the sender. In deceptive scenarios senders can display both genuine and deceptive cues. Having higher trait empathy may only increase the incorrect classification of such cues (i.e. assuming deceptive cues are genuine), due to individuals being either more trusting of others' statements (e.g., Baker et al., 2013) or less analytical of others' behaviours (e.g., relying more on stereotypical thinking; Posten & Mussweiler, 2013).

Participants had to detect deception in a set of videos depicting everyday lies. Their ability to recognise emotions from subtle cues (partial expressions of an emotion), and microexpressions (full faced flashes of emotions), and empathy level was measured. This allowed to contrast various hypotheses relating emotion to deception. If there are no reliable emotional cues that reveal deception in low-stakes lies, then facial cue recognition and empathy will be unrelated to accuracy. Secondly, if there are reliable emotional cues present even in low-stakes scenario that identify veracity, then the ability to recognise those cues should positively relate to detection (e.g., detecting truthful cues during honest statements).

However, if the social aspect of empathy interferes with the classification of the recognised emotional cues (i.e. misclassifying deceptive cues as genuine), then empathy should correlate negatively with deception detection.

**Method**

***Design.*** A within-subjects correlational design was employed. The independent variable was the veracity of the videos (Truth or Lie), and dependant variables were the truth and lie accuracy scores, the confidence of each decision, empathy, and the subtle expression and microexpression scores.

***Participants.*** 42 participants (16 male, 26 female) were recruited using the UCL's Sona Systems® Online Subject Pool. Participants had a mean age of 23.7 ($SD$ = 9.7). They received course credit or £1 for their time. Informed consent was obtained from all participants.

An a priori power analysis (using G*Power 3.1) indicated that a sample size of around 40 participants is recommended to have a 95% power of detecting a medium (0.5) size effect, at the traditional .05 criterion of statistical significance.

***Stimuli/Materials.*** 20 videos (10 lies and 10 truths) were selected from the BDS (Street et al., 2011). The videos were controlled for gender in each veracity, and were presented in the same order to all participants. As the senders were given no incentive to lie it can be assumed the lies are low-stakes.

Individual differences in empathy were measured using the Interpersonal Reactivity Index (IRI; Davis, 1983). This multidimensional empathy measure consists of 28 questions, 7 questions specific to each of the four subscales, Perspective-taking (PT), Fantasy (FS), Empathic Concern (EC), and Personal Distress (PD), to which individuals respond using a letter from A (does not describe me well) to E (describes me very well). These sub-scales relate to the two subcomponents of the empathy construct, Cognitive and Emotional empathy. The IRI has high internal and external validity (Davis & Franzoi, 1991), and good test-retest reliability (Bartholow, Sestir, & Davis, 2005; Davis, 1983).

For the facial recognition component of the study two specific tools were used. The Micro Expression Training Tool (METT; Ekman, 2002) was developed for training in the recognition of microexpressions of the seven basic emotions. The software offers a Pre- and Post-Test, Training videos and Practice. For the current experiment the Pre-Test section was used, consisting of 14 colour portrait photographs (360x360 pixels) of facial expressions of emotions (Japanese and Caucasians), 2 for each of the seven universal emotions (happiness, anger, sadness, disgust, fear, surprise, and contempt). The maximum test score is 100%. The METT has been used in past studies (e.g., Endres & Laidlaw, 2009; Frank & Ekman, 1997; Warren et al., 2009), and was designed based on the Brief Affect Recognition Test (BART) which has good validity and reliability (Matsumoto et al., 2000).

The Subtle Expression Training Tool (SETT; Ekman, 2002) trains the recognition of subtle expressions. The "Practice" session of the software was used, which offers a test of subtle expressions recognition, providing a percentage score at the end. The task comprises of 37 expressions, belonging to the seven basic emotions. All expressions are presented using the same Caucasian female, and are portraits in black and white. The speed of presentation of the expressions is set at the start, 1 (slowest) to 6 (fastest); the setting of 3 was used in this experiment.

***Procedure.*** Participants watched each video and made a veracity decision (forced choice: lie or truth), and indicated their confidence in each veracity decision on a 5-point scale. Afterwards, participants completed the SETT and METT tasks (counterbalanced). The SETT provides ongoing feedback to the user, and allows them to "Try Again" if they respond incorrectly; however, participants were told to ignore this and progress to the next expression. The two test scores were recorded. Finally they were given the IRI. At the end of the experiment all participants were fully debriefed.

**Results**

The data was initially screened for outliers[2]. One data point was excluded from all subsequent analyses. The final sample was $N = 41$, (15 male, 26 female). Overall performance on the deception detection task was 55% ($SD = 2.10$). A one-sample t-test revealed that the difference from chance performance was significant, $t(40) = 3.04$, $p = .004$, 95% CI [.33, 1.62], $d = 0.96$. Accuracy for the truthful videos was 62% ($SD = 1.46$) and for the lie videos was 48% ($SD = 1.42$), two additional t-tests comparing each veracity revealed that truth accuracy was significantly above chance, $t(40) = 5.36$, $p < .001$, 95% CI [.76, 1.68], $d = 1.58$, but lie accuracy was not, $t(40) = 1.09$, $p = .28$, 95% CI [-.69, .21], $d = 0.31$; performance differences between veracities was also significant, $t(40) = 4.63$, $p < .001$, 95% CI [2.10, .82], $d = 1.46$.

Overall, decoders were significantly truth-biased in their responses, $t(40) = 4.63$, $p < .001$, 95% CI [1.65, 4.21], $d = 1.46$. As one of the propositions of the current experiment is that empathy has a biasing function with respect to veracity judgments, the potential relationship between empathy and truth-bias was investigated using a Pearson's correlation. But, the correlation was not found to be significant, $r(40) = .128$, $p = .43$, 95% CI [-.15, .36].

Participants were able to recognise microexpressions with 65.46% ($SD = 14.30$) accuracy, and subtle expressions with 61.25% ($SD = 10.30$) accuracy. To assess whether accuracy was related to the ability to detect subtle expressions and microexpressions, METT and SETT[3] scores were correlated using Pearson's correlations with overall accuracy on the deception detection task, and with the truth and lie detection accuracies. For the METT neither overall accuracy, $r(41) = .002$, $p = .99$, 95% CI [-.27, .28], nor truth, $r(41) = .072$, $p = .66$, 95% CI [-.21, .37], or lie, $r(41) = -.07$, $p = .66$, 95% CI [-.39, .25], accuracy were significantly correlated. Similarly, no significant correlations were found for the SETT

[2] Using Cook's distance, with a cut-off criteria of 0.5.

[3] Due to incomplete data, one participant was removed from analyses involving the SETT scores. The sample for these analyses is $N = 40$, 14 male, 26 female.

scores and accuracy either; for overall, $r(40) = -.214$, $p = .19$, 95% CI [-.44, .04], truth, $r(40) = -.194$, $p = .23$, 95% CI [-.48, .09], or lie accuracy, $r(40) = -.108$, $p = .51$, 95% CI [-.38, .14]. Subsequent analyses found a positive correlation between empathy and micro-expression recognition, specifically between the Cognitive empathy factor and METT, but the result was only marginally significant, $r(40) = .306$, $p = .055$, 95% CI [-.07, .68].

To investigate the relationship between accuracy and empathy a series of correlations were conducted. The analysis using overall accuracy and empathy scores revealed a significant negative correlation, $r(40) = -.382$, $p = .015$, 95% CI [-.63, -.04]. Planned comparisons for each veracity accuracy with empathy revealed the predicted significant negative correlation between lie detection accuracy and empathy, $r(40) = -.369$, $p = .01$ (one-tail), 95% CI [-.60, -.41], but no positive correlation between truth detection accuracy and empathy, $r(40) = -.187$, $p = .12$ (one-tail), 95% CI [-.47, .13] see Figure 7.

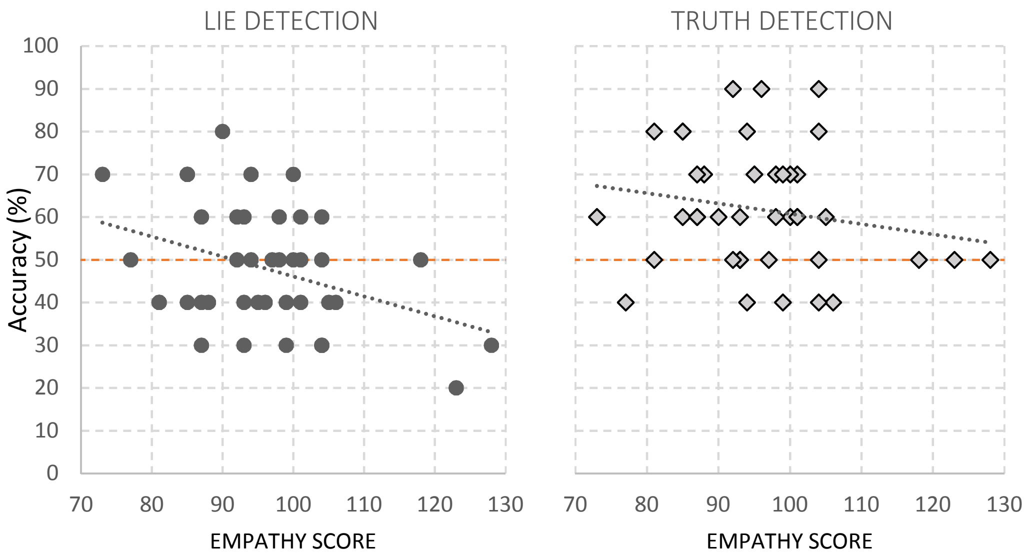


Figure 7. Empathy score correlations with Lie Detection (a) and Truth Detection (b). A negative correlations between Lie Detection Accuracy and Empathy scores; the dotted line represents chance performance (50%).

To explore this relationship, the accuracy for the upper, Q1 (Mean = 39%), and lower, Q4 (Mean = 51%), quartile empathy scores were tested against chance performance

(50%) revealing that only the upper quartile was significantly below chance level at detecting lie videos, $t(8) = -2.63$, $p = .03$, 95% CI [-2.1, -.14], $d = 1.86$, although, the difference between the two groups was just shy of significance, $t(17) = 1.87$, $p = .079$, 95% CI [-.16, 2.58], $d = 0.86$.

It may be assumed that due to the strong interconnected nature of empathy and facial recognition, that trait empathy may mediate the relationship between facial cue recognition and accuracy. However, investigating such a mediation analysis did not provide any further insight into this relationship (i.e. neither the direct, $b = .015$, $t(40) = .63$, $p = .532$, or indirect, $b = .001$, $t(40) = .011$, $p = .991$, effect proved to be significant).

Finally, to understand if empathy had an effect on the reason decoders gave when judging veracity a chi-square analysis was conducted. A median-split of the empathy scores was conducted (Median = 49), separating the sample into High and Low empaths, which were then compared to the frequency with which they utilised each of the 7 reasons in their judgments. The result of the analysis did not find a significant difference between the two groups, $X^2$ (6, $N = 40$) = 7.83, $p = .251$.

**Discussion**

This experiment investigated an unexplored aspect of the emotion-based approach to detecting deception by considering a potential detrimental effect of emotion recognition on veracity judgements of everyday lies. The predictions made were that reliance on emotional information during veracity judgments can have a detrimental effect on accuracy, due to differences in the perception of senders' message.

For facial cue detection, the results show that in everyday lying scenarios one's ability to correctly recognise subtle expressions and microexpressions is not related to detecting deception. However, accuracy for detecting these expressions was very high, suggesting decoders were capable of accurately perceiving and interpreting such brief cues. The fact that METT and SETT scores did not correlate with accuracy is not surprising for two reasons. These tools measure the overt process of classifying emotions into distinct categories based on fast processing of facial configurations; however, in a deceptive scenario if such facial cues are absent (e.g., the sender does not have strong emotions towards their statement) then classification ability is useless and produce no effect; this is in line with the emotion-based approach perspective. Secondly, even if emotional cues are present the ability to detect facial expression does not automatically suggest that individuals can access this information directly to aid their detection performance (see ten Brinke et al., 2014).

The lack of correlation between the two types of expressions can be attributed to the difference in decoding approaches utilised for each type. Microexpressions are intense, prototypical, and unambiguous expressions (see Ekman & Friesen, 1976), where a pattern-matching approach to decoding can be successful, while subtle expressions are weak and ambiguous facial cues (Ekman, 2003a; Motley & Camden, 1988), which may be better served by adopting a more mentalizing approach, facilitating the decoding of the ambiguous expression based on contextual information. This would be an interesting avenue for future research into facial recognition processes.

With regards to the relationship between facial cue recognition and empathy, it was found that subtle expressions and microexpressions do not correlate with empathy, but a trend for the latter was observed. The positive trend between cognitive empathy and microexpression detection seems to support claims that facial expression recognition is related to the construct of empathy (e.g., Glass & Newman, 2006), and is activated even at subliminal presentations (Prochnow, Kossack, et al., 2013). The lack of correlation between empathy and subtle expression may reflect their partial and more ambiguous nature, potentially, not allowing for a sufficiently strong facial feedback effect from mimicry. However, it is difficult to speculate further, as past findings on this issue have been inconsistent, with some reporting facial expression recognition correlating with emotion perception tests (Chikovani, Babuadze, Iashvili, Gvalia, & Surguladze, 2015), while others findings no relationship (Roberts et al., 2006). These findings suggest that emotion recognition ability may be necessary but potentially not sufficient for detecting emotional cues related to deception (e.g., Wojciechowski et al., 2014).

The more interesting result, which supports the current prediction for emotion recognition and deception, is the negative correlation between empathy and deception detection. The results reveal that higher trait empathy is detrimental to detecting lies. There are several interpretations for this finding. People who are more empathic may be more inclined to believe deceptive sender's statements are genuine (i.e. gullible or trusting), leading to worse lie detection. However, bias in responding did not correlate with empathy scores, suggesting empathy does not lead to a systematic response tendency, and may relate to a misinterpretation of a specific source of information leading to worse detection. It may be that having higher empathy hinders the decision-making process as too much attention is paid to irrelevant cues (e.g., superficially analysing information; Peace & Sinclair, 2012), and using a more pro-social schematic processing of incoming information, while lower empaths may use a different processing style, such as being more analytical when interpreting emotional cues or looking more towards other sources of information (e.g., message content).

Empathy does not seem to be a trait that facilitates the recognition of genuine affect (as would be assumed by the emotion recognition account). Indeed, some research suggests that empathy only relates to the *speed* of facial processing, assisting in recognising expressions faster, and not accuracy (Kosonogov, Titova, & Vorobyeva, 2015; Petrides & Furnham, 2003). People have a social contract regarding emotional communications, being less suspicious and scrutinising of others' affect, as they prefer avoiding hurt feelings over simple matters. Highly empathic individuals may have a stronger predisposition towards this schema for social interaction, resulting in a reduced willingness to analyse emotional information for veracity (e.g., processing the information superficially, based only on appearance). Research has shown that being more trusting leads to more stereotypical thinking towards others (Posten & Mussweiler, 2013), while being more suspicious can encourage more effortful thinking (Forrest, Feldman, & Tyler, 2004). Low empaths' movement away from believing the message of the sender is an accurate representation of their internal affect could be the reason for the improved performance in detecting lies. It should be noted that in the present experiment attentional abilities were not measured, therefore the question arises as to whether the results are due to cognitive differences rather than emotional perception per se.

Therefore, while empathy is useful in predicting others' affect and behaviour, these predictions are only accurate if the emotional cues being decoded are genuine. This explanations extends from research on the *correspondence bias*, the predisposition of receivers to regard communication as reflecting the true underlying dispositions of the sender (Gilbert & Malone, 1995; Jones, 1979). This is separate from the general truth-bias, which reflects a general predisposition to assume all communication is genuine, regardless of actual veracity. Empathy biases veracity judgements by affecting the likelihood that a perceived emotional cue, genuine or deceptive, is interpreted as reflecting the true affective state of the sender. Indirect support of this assertion is found in research of facial cue detection, finding people can detect masked expressions (i.e. recognise leaked cues; Ekman et al., 1988; Warren et al., 2009), but fail to classify simulated expressions as inauthentic (Soppe, 1988). Thus, empathy may be better described as a tool for promoting interpersonal relationships at the expense of accurate detection of intent.

An important finding in this study is that the accuracy rates observed for lies and truths were not lower than those observed when utilising high-stakes lies (e.g., Porter et al., 2012), contradicting claims that accuracy scores are a product of the emotion related cues displayed by liars (e.g., DePaulo, et al., 2003). As the lies told in this experiment were considered low-stakes, it implies that emotional (or cognitive) information is not a primary source used by decoders to assess veracity (Hartwig & Bond, 2014).

The finding that facial expression recognition does not benefit deception detection is important as it contradicts a basic premise of the emotion-based approach to detecting deception. While a limitation of the current experiment was the use of low-stakes lies and truths, which can be argued to be mostly absent of emotional information, this does not explain why accuracy was not higher for truthful statements where senders are more likely to display affective behaviour normally associated with communication (DePaulo et al., 1988; see also, Zloteanu, 2015). Additionally, the stimuli set has been shown to contain significant differences in smiling, hand and body movements between the two veracities (i.e. more so during lies; Street et al., 2011). Clearly, even in such low-stakes lies and truths there are behavioural differences that can be used to ascertain veracity, however, neither forms of facial cue detection aided classification accuracy. Furthermore, the presence of such behavioural differences corroborates my interpretation of empathy as predisposing decoders to misclassify emotional cues. If high empaths can more easily detect that a sender (i.e. liar) is smiling, but not if it is authentic, they may be more likely assume this to be genuine positive affect, and not to an attempt to deceive (i.e. posing a smile). The next step requires the use of high-stakes lies and truths, where emotional cues are more abundant, to uncover if empathy leads to higher accuracy in such scenarios, uncovering if a potential optimal level of emotional information is required.

**Experiment 3: The Effectiveness of Emotion Recognition Training on Low-Stakes and High-Stakes Deception Detection**

The emotion-based approach to detecting deception posits that using emotional cues produced during deceptive and truthful communication (i.e. leakage) a decoder can determine the veracity of a statement. However, accuracy of decoders is generally low, as most are unable to perceive such cues, or have incorrect knowledge as to their presentation and meaning. The former arguments have been shown in Experiment 2 to not hold, as decoders regardless of deception detection performance were very accurate at detecting both microexpressions and subtle expressions. The latter assumption will be explored in the current experiment. Subsequently, another core argument for the low accuracy is that most deception detection research focusses solely on low-stakes lies, where behavioural differences between lairs and truth-tellers are reduced. In Experiment 2, veracity judgements were made utilising only low-stakes lies, due to the decision to separate emotional cue detection to how empathy can impact veracity judgements, therefore this assumption could not be tested directly. In this experiment decoders were shown both low-stakes and high-stakes lies, to allow for a direct test of this core assumption.

If emotions are important to deception then having knowledge of their associated displays and significance to veracity should produce an advantage in detecting deception. The allure of the emotion-based approach is the universal nature of these cues—as facial expressions are said to be displayed identically cross-culturally—any training in detecting them should be generalizable to all situations where they appear (Frank & Ekman, 1997).

Ekman (2009a) claims that using microexpressions can result in near perfect accuracy, and that these cues can be taught to anyone; although, he has yet to produce any peer-reviewed findings to support this claims. However, while micro- and subtle expressions may occur too quickly to be perceived by naïve individuals, their identification does improve with training (Ekman & Friesen, 1974; Hurley, 2012; Matsumoto & Hwang, 2011). Importantly, training studies that contain information about classifying genuine and faked emotions seem to show a positive effect on detecting deception (e.g., Shaw, Porter, & ten Brinke, 2013), as do studies using microexpression training (Frank & Ekman, 1997). However, this seems to not generalize to all forms of deception (e.g., useful for mock crimes, but not lies about opinion; Matsumoto et al., 2014).

Aside from the theoretical value of assessing the validity of emotion-based training techniques, it also has clear and important real-world relevance due to its prevalent use in certain police and security training programs. For example, the Transportation Security Administration in the USA has made substantial financial contributions to developing and utilising a technique called Screening Passengers by Observation Techniques (SPOT), largely based on microexpression research (Weinberger, 2010). Understanding if facial cues are useful in detecting deception has relevance not only for our scientific understanding of nonverbal communication and human decision-making in situations of uncertainty, but to uncover if these techniques are viable or erroneous.

***Effects of Training on Veracity Judgements.*** A consistent finding in deception research is that people are truth-biased when it comes to deception detection (Levine et al., 1999). A side-effect of training is the change it produces to this baseline judgement. Training, due to increased suspiciousness (Stiff et al., 1992), makes individuals more readily assume others are being deceptive, leading to an overestimation of lies in a sample. A proof of concept study using non-diagnostic cues found that if decoders are trained on "cues of deceit" they demonstrate an increase in lie-biased responding (the reversal of the truth-bias), while training decoders on "cues of honesty" results in an increase in the truth-bias (Masip et al., 2009). Even training using alleged veritable cues of deception results in the reversal of the truth-bias (Kim & Levine, 2011; Levine, Serota, et al., 2010).

A secondary effect of training on judgement is increased confidence in one's decisions, irrespective of actual accuracy (DePaulo & Pfeifer, 1986). For example, Kassin and Fong (1999) trained their participants with the Reid technique, an established (but questionable) police interrogation technique which focuses highly on nonverbal cues, and compared them to a no-training condition, finding poorer performances from the trainees, while also finding they were more confident in their (erroneous) assessments.

Another aspect of training research that has rarely been considered is the effect of the mere act of receiving training. Levine and colleagues (Levine et al., 2005) have demonstrated that some of the effects of training on deception detection are simply due to attentional changes brought about by the nature of the task. Any improvement in performance or effect on response bias may be due to training simply focusing individuals on the task at hand and motivating them to perform well (i.e. "catch" the liar), and has little to do with accurately applying specific knowledge (e.g., DePaulo, Lassiter, & Stone, 1982).

***Stakes Surrounding the Lie or Truth.*** A prevalent argument for increasing detectability of deception is increasing the stakes surrounding the lie (i.e. the risks and rewards to the deceiver). In everyday scenarios individual lie often, but the stakes involved in such lies are low, and liars will experience less intense emotions. However, studies on low-stakes lies still find nonverbal cues, but fewer in number and intensity to their high-stakes counterparts, suggesting behavioural cue production lies on a continuum (Hartwig & Bond, 2011; Porter & ten Brinke, 2010).

When the stakes are high, liars experience increased arousal and anxiety, intensifying the emotions associated with the lie, resulting in more nonverbal differences from truth-tellers. Stakes also make controlling one's channels of communication more difficult as liars dedicate more resources towards a believable performance (DePaulo et al., 1988; Ekman & Frank, 1993; Levine et al., 2005). In high-stakes scenarios there are significant differences in emotional expressions displayed by liars and truth-tellers, however, decoders tend to not perform better even in such scenarios (Porter & ten Brinke, 2008; ten Brinke & Porter, 2012; ten Brinke et al., 2012; ten Brinke, MacDonald, Porter, & O'Connor, 2012). Although, a few studies investigating detecting deception from high-stakes lies find that they are indeed easier to distinguish than their low-stakes counterparts (Mann, Vrij, & Bull, 2002; Vrij, Mann, Robbins, & Robinson, 2006), especially when using nonverbal channels (visual and audio-visual; DePaulo et al., 1988).

While the emotion-based approach argues that high-stakes lies should be easier to detect, empirical support for this claim has been mixed. The meta-analysis by DePaulo and colleagues (2003) reported that the effect of motivation, a close proxy to stakes, was a significant factor in the detectability of deception, however, a more recent meta-analysis failed to replicate this finding (Hartwig & Bond, 2014).

Importantly, detection of high-stakes lie seems to receive the most benefit from training compared to low-stakes lies (e.g., Shaw et al., 2013). Although this too has not been shown to be consistent. The meta-analysis by Frank and Feeley (2003) found training effectiveness is moderated by stakes, while neither recent meta-analyses by Driskell (2012) or by Hauch et al. (2014) found stakes to be a moderator of detectability.

***Present Study.*** The current experiment addressed this inconsistency, attempting to understanding if in high-stakes scenarios, where there are objectively more behavioural cues, decoders fair better at discriminating veracity based on their ability to detect emotional cues. Additionally, the assumption that accuracy can be increased through training in recognising emotional cues was tested. I provided high- and low-stakes lies for participants to decode, aimed at assessing the usefulness and limitations of training on different decoding scenarios. Secondly, I manipulated the decoders' ability to recognise emotional cues, by providing emotion recognition (facial cue detection) training, and a bogus training condition to control for any spurious effects (e.g., heightened vigilance), as compared to receiving no training. There were two independent predictions based on the stakes to the liar. For low-stakes it was predicted that emotion recognition training would result in improved truth detection, due to senders expressing genuine emotions in their statements, but decreased lie detection, as leakage cues are scarce or absent, and individuals may also misinterpret faked emotional cues as honest. For high-stakes it was predicted that emotion recognition training would produce an overall improvement in deception detection, as there are ample emotional cues (e.g. truthful and leaked) that individuals can use to classify veracity.

## Method

***Design.*** A three-way mixed design was employed. The independent variables were the between-subjects variable Training type with three levels (Emotion Recognition Training, Bogus Training, and No Training), and the within-subjects variables Veracity (Lie and Truth) and Stakes (High and Low). Due to the considerable differences between the Low-stakes and High-stakes video sets, the analyses were conducted separately. The dependent variables were Accuracy, Confidence, and self-reported Mood.

***Participants.*** One hundred and six participants (22 male, 84 female), were recruited through UCL's Psychology Subject Pool. Participants had a mean age of 20.9 (*SD* = 4.7). They received course credits for their time.

***Materials.*** *Video Stimuli.* 20 low-stakes videos (10 lies and 10 truths) were selected from the BDS. As the senders were given no incentive to lie it can be assumed that the stakes were low (i.e. low-stakes lies). The videos were controlled for gender in each veracity, and no sender was used twice.

The 20 high-stakes videos (10 lies and 10 truths) used in the study by Warren et al. (2009) were used. Initially, senders recorded a brief (30s) description of their hobbies or interest, which served as a baseline of their behaviour, and then watched a Hawaiian landscape footage or a surgical procedure (in counterbalanced order), used to induce mildly positive or severely negative affective responses (see also Ekman, et al., 1988). They were instructed to describe what they saw as if it were the opposite video. For their second recording, the senders watched the remaining video and described it truthfully. The final videos are approximately 1 min in length, each containing a baseline and either a deceptive or truthful description. For the current experiment the two subsets of these videos were also considered. These are the Emotional videos (5 lies and 5 truths), where the senders watched the surgical videos, and Unemotional videos (5 lies and 5 truths), where the senders watched the Hawaiian beach scene. The senders in all videos were told that "their performance would be judged" and if successful in their deception they "would win £10" (Warren et al., 2009, p. 62). Due to the added motivation to the senders the lies are considered to have higher stakes than the Bloomsbury set, and will be considered as high-stakes lies.

*Micro Expression Training Tool (METT).* As in Experiment 2, the METT tool was used, but for training purposes. It contains a training and a practice component, both meant to teach individuals the differences between the seven basic emotions. The training contains 4 videos describing facial expressions of emotion; it provides distinctions between muscularly similar expressions (e.g., Surprise and Fear), and explains their correct interpretation. The practice component contains 28 faces expressing microexpressions, to which users respond by selecting one of seven emotions. If they make an incorrect choice, they can press a button that reveals the expression. The user decides at which rate they want to progress through the faces.

*Subtle Expression Training Tool (SETT).* The SETT trains recognition of subtle expressions. The “Get Acquainted” and “Practice” components of the SETT were used for the training. The first component contains a list of all seven emotions. The user sees several subtle expressions for each emotion and is given written explanations as to their interpretation. The user decides the progression rate through each emotion. Afterwards, the user moves to the practice component. This involves a test of recognition ability, where expressions are presented, at a speed determined by the user, whom is asked to identify each expression using the list of seven emotions. For the training the slowest speed was used to give participants time to fully understand the expressions. Participants were allowed to use a “Try again” function if they identified an expression incorrectly. The task comprises of 37 expressions, all in black-and-white and presented using the same Caucasian female.

***Procedure.*** Participants were randomly assigned to one of three categories: Emotion Recognition Training (*n* = 39), Bogus Training (*n* = 38), and No Training (*n* = 29). After participants were assigned to their specific condition, they received the appropriate training for their group. Then they were presented with the video sets (counterbalanced).

For each video they were asked to state their veracity decision (forced choice: lie or truth), and state their confidence in their decision using a 5-point Likert scale. Then, participants were given two questions about their current mood and the perceived effectiveness of the training. The mood question was posed as “How do you feel at this moment?” to which participants responded using a number from 1 (Extremely sad) to 5 (Extremely happy). The effect that mood may have on training and deception detection was considered as mood influences emotion recognition, especially for facial expressions (e.g., Chepenik, Cornew, & Farah, 2007; Schmid, Mast, Bombari, Mast, & Lobmaier, 2011). The training effectiveness question was posed as "How effective was the training program?" to which participants responded using a number from 1 (Not at all Effective) to 5 (Extremely Effective).

*No Training (NT).* In the control condition participants were given two video tasks, Low-stakes and High-stakes to watch directly, providing veracity and confidence responses, but were not supplied any additional information regarding deception detection. The total time of the condition was around 35 minutes.

*Emotion Recognition Training (ERT).* In the training condition participants were given the METT and SETT tasks (counterbalanced). They were allowed to progress through each component of the training at their own pace. The two video tasks were then presented. The total time of this condition was around 65 minutes.

*Bogus Training (BT).* In the bogus training condition participants received a custom made training program containing no actual cues of deception or information on how to detect liars. The program was created using the neutral expressions of the METT practice component. Participants were told that the task trains them to "spot subtle differences in the face, which translate to spotting cues of deception". They were shown a fixation cross, followed by a face, which stayed on screen for a predetermined amount of time, then replaced with a fixation cross followed by a multiple choice question. There were three blocks in the program: slow, with a presentation time of 1s per face, medium, with a .75s presentation time, and fast, with a .5s presentation time. There were 18 faces in each block, controlled for gender. The questions regarded the age, eye colour, hair colour, and facial feature of the person in the image. For each question they were give a multiple choice answer with four possible responses, for example "What was the person's eye colour?" with the possible answers being "A. Blue, B. Green, C. Brown, D. Black" (see Figure 8). The bogus training was created in Matlab (R2012b, v8.0). Afterwards participants were given the two video sets. The total time of the condition was around 45 minutes.

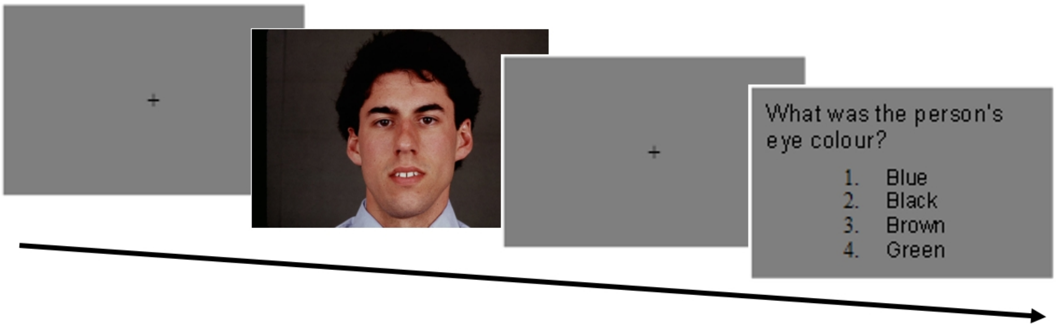


Figure 8. Example from the Bogus training task used for the BT group.

**Results**

Overall deception detection accuracy on the two video tasks was 55.35% for the Low-stakes videos, and 44.6% for the High-stakes video. A comparison of mean accuracy between conditions is illustrated in Figure 9.

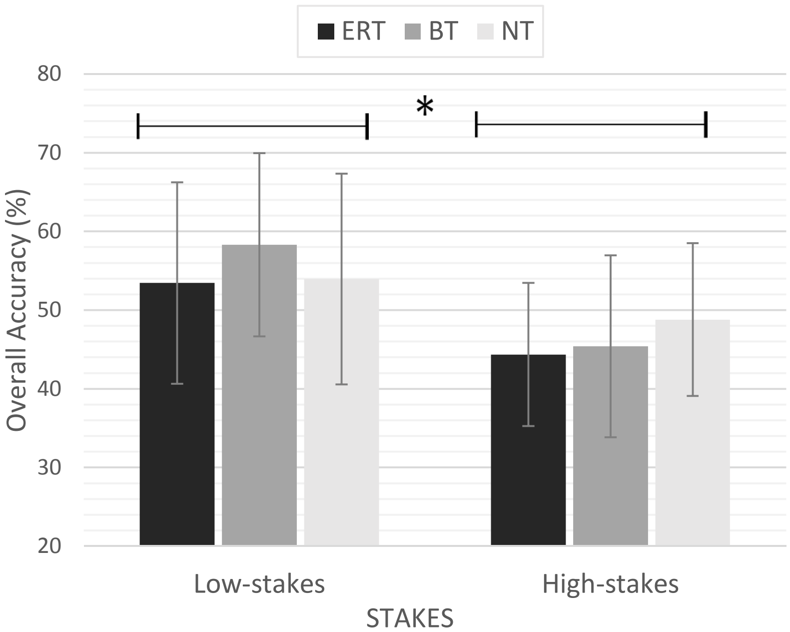


Figure 9. Means (and Standard Deviations; error bars) for each training condition, Emotion recognition training (ERT), Bogus training (BT), and no training (NT) by video set. The line over the bars represents the main effect of Stakes. The asterisks represents a significant difference of $p$<.001.

A manipulation check of effectiveness ratings revealed no difference of training effectiveness between the real training and bogus training conditions, $t(75) = -.241$, $p = .81$, 95% CI [.28, 1.12], suggesting the two conditions were perceived similarly. The analysis of mood showed that participants reported being in a better mood in the ERT condition ($M$ = 3.3, $SD$ = .8), compared to the BT conditions ($M$ = 2.6, $SD$ = 1.1), which were both higher than NT ($M$ = 1.9, $SD$ = 1.3), $F(2,106) = 12.3$, $p < .001$, $\eta_p^2 = .192$. However, including mood in the subsequent analyses did not produce any change in effects.

***Low-Stakes.*** To investigate if the training condition had an effect on accuracy an ANOVA was conducted comparing overall accuracy with the three experimental conditions. Results revealed that training had no effect on accuracy, $F(1,106) = 1.70$, $p = .188$. To account for differences between veracities, the two accuracy scores, Truth and Lie, were analysed. Neither Truth, $F < 1$, ns., nor Lie accuracy scores, $F(1,106) = 1.64$, $p = .198$, were affected by training; nor was there an interaction of veracity and training, $F < 1$, ns. The veracity analysis comparing truths and lies accuracy scores did reveal a main effect, finding that, overall, lies were harder to detect ($M$ = 46.8%, $SD$ = 15.4%) than truths ($M$ = 63.9%, $SD$ = 16.8%), $F(1,103) = 74.4$, $p < .001$, $\eta_p^2 = .419$.

The analysis of training on confidence found that participants in the BT condition showed the highest confidence in their decisions, $M$ = 66.3 ($SD$ = 10.29), followed by ERT, $M$ = 63.41 ($SD$ = 8.31), and NT, $M$ = 61.97 ($SD$ = 10.30), but the difference was not statistically significant, $F(2,105) = 1.85$, $p = .16$.

An analysis to uncover if ERT or BT influenced participants' bias in responding to the low-stakes videos, compared to receiving no training, revealed no significant effect of training on bias, $F < 1$, ns. However, overall participants were truth-biased in terms of their responses, $t(105) = 8.61$, $p < .001$, 95% CI [2.63, 4.20], $d = 1.67$.

To verify the results of Experiment 2, a correlation was conducted between trait empathy and accuracy in detecting low-stakes lies (separated by Group). The NT group showed a marginally significant negative correlation, *r*(29) = -.281, *p* = .07 (one-tail), 95% CI [-.61, .15], replicating the results of the previous experiment (the lack of a stronger effect can be attributed to the smaller sample size) (Figure 10). A similar negative relationship was observed for the BT group, however, it did not reach significance, $p > .10$. Interestingly, the ERT group showed a marginal positive correlation with accuracy, *r*(38) = .218, *p* = .09 (one-tail), 95% CI [-.13, .49].

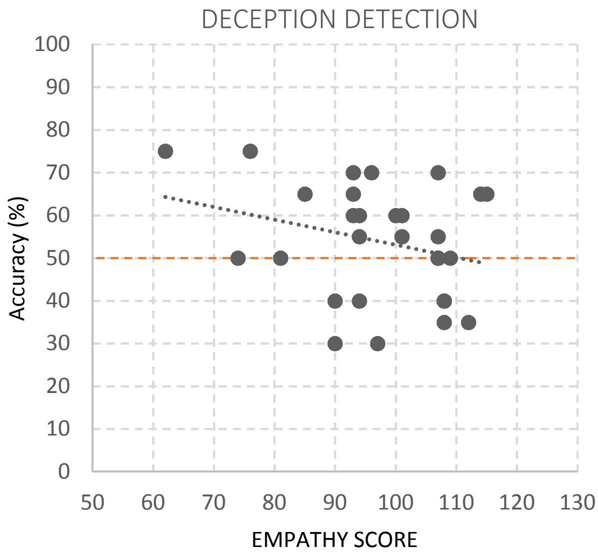


Figure 10. Negative correlation for the NT group between Empathy and Low-Stakes accuracy; the dotted line represents chance accuracy (50%).

***High-Stakes.*** The ANOVA comparing overall accuracy with the three training conditions revealed no effect on detecting high-stakes deception, $F < 1$, ns. Looking at each veracity individually reveals that, neither Truth, $F < 1$, ns., nor Lie accuracy scores, $F < 1$, ns., were affected by training. Overall, a main effect of veracity was found, where Lies (*M* = 42.5%, *SD* = 15.8%) were harder to detect than truths (*M* = 48%, *SD* = 13.6%), $F(1,103) = 7.63$, $p = .007$, $\eta_p^2 = .069$.

The ANOVA comparing confidence between the three training conditions of the high-stakes videos did not find a significant result, $F < 1$, ns. Additionally, the bias analysis for the high-stakes videos revealed no significant effect of training, $F(2,106) = 1.03$, $p = .36$.

The results also revealed that overall participants were significantly truth-biased, $t(105) = 5.88$, $p < .001$, 95% CI [2.04, 4.11], $d = 1.15$.

The correlations of high-stakes deception detection accuracy was compared to empathy scores based on each group. For the NT and BT groups, only a trend indicating a negative relationship between the two variables was observed, $p > .10$. For the ERT group, empathy scores were unrelated to accuracy.

*High-stakes Emotional vs. High-stakes Unemotional Videos.* To account for the effect of the type of emotions present within the high-stakes videos a subsequent analysis was performed on the two subsets, High-stakes Emotional (HSE) and High-stakes Unemotional (HSU) videos. The results of the ANOVA revealed that the type of lie told had the only significant effect on accuracy, F(1,102) = 142.3, p < .001, $\eta_p^2 = .583$, with HSE videos showing higher accuracy ($M = 57.4\%$, $SD = 16.5\%$), compared to HSU videos ($M = 31.9\%$, $SD = 12.9\%$).

As in the previous experiment, empathy was argued to bias perception of deceptive emotions, two correlations were conducted assessing if HSU or HSE accuracy correlates negatively with empathy. The NT group, while in the predicted negative direction, did not show significant correlations, for either set, $p > .10$. However, the few data points may explain this lack of an effect.

***High vs. Low Stakes.*** To investigate all potential differences between the Stakes conditions, an analysis comparing Training and Stakes was also conducted. The results show a main effect of Stakes, $F(1,103) = 47.16$, $p < .001$, $\eta_p^2 = .314$, with better performance for Low-stakes videos. Yet, training did not show an effect on accuracy, $F(2,103) = 1.62$, $p = .20$, nor an interaction with Stakes, $F < 1$, ns.

The accuracy difference between the two deception videos sets was also investigated based on veracity (Truth and Lie), using two ANOVAs. A statistically significant difference in Truth accuracy based on stakes was observed, $F(1,103) = 58.08$, $p < .001$, $\eta_p^2 = .361$, with low-stakes ($M$ = 63.9%, $SD$ = 16.8%) showing higher accuracy than high-stakes ($M$ = 48%, $SD$ = 13.6%), but no effect of training on performance was found. Stakes showed a marginally significant result for Lie accuracy, $F(1,103) = 3.59$, $p = .06$, $\eta_p^2 = .034$, with low-stakes ($M$ = 46.8%, $SD$ = 15.4%) showing higher accuracy than high-stakes ($M$ = 42.5%, $SD$ = 15.8%). No other effects were found to be significant.

**Discussion**

The current study looked at how the type of lie and training in recognising facial expressions of emotion can influence deception detection accuracy. Specifically, it aimed to uncover if emotion recognition training improves accuracy when judging high-stake lies, where emotion cues are hypothesised to be abundant, compared to low-stake lies, where cues should be scarce or absent, and considering the psychological effects of simply receiving training and the type of emotions expressed by deceivers.

***Training and Deception Detection.*** The results revealed that neither real training nor bogus training resulted in difference in judgement in comparison to the control. This effect was absent in both high-stakes and low-stakes lies. It seems that training in facial expression recognition (microexpressions and subtle expressions) does not translate into increased accuracy in detecting any type of deception used in this experiment. The data did indicate that the bogus training condition showed a slight increase in accuracy, supporting claims that simply paying more attention to the deceiver may improve accuracy (e.g., Levine et al., 2005). This trend may have been driven by participants being free to focus on the videos, without having to remember any cues, reducing their cognitive workload.

Additionally, no artificial change in confidence was found as a result of receiving actual or bogus training. Perhaps the detection tasks were considered difficult and training did not ease the process enough, tempering confidence. Finally, while past research suggests that in situations where participants expect deception to occur (i.e. increased suspiciousness) they are more likely to judge others as being deceptive instead of truthful the current results do not show any effect of training on bias, as participants remained truth-biased in all conditions.

***Stakes and the Emotionality of Lies.*** The use of both high and low-stakes stimuli provided a direct comparison of individuals' veracity judgements. This served several purposes, the most relevant being to directly address the claim that raising the stakes increases detectability, secondly, that high-stakes lies contain more emotional leakage cues which should benefit ERT, and finally, to serve as a direct test for the variability of deception detection performance under various scenarios.

When comparing the detection rates of participants for the two types of stimuli it was found that accuracy for low-stakes videos was superior to that of high-stakes videos, contradicting claims that deception detection should be easier under conditions of increased stakes to the liar (cf. Evanoff, Porter, & Black, 2014). While it is difficult to address directly this finding as there were multiple differences between the two video sets which may be influencing the results, an explanation for why participants performed better on the Low-stakes videos is that the content of the videos was more important for the veracity judgment than nonverbal cues.

In the High-stakes videos the lies told are practically the same (i.e. lie about either the surgery or the beach scene), only the sender changes. In contrast to this, the Low-stakes videos contain unique lies on a similar theme; the fact that these stories contained additional information (e.g., specifics about a country) may have led to the increase in accuracy. This suggests that non-emotional cues may be easier to utilise to detect deceit than cues relating to leaked emotions. Alternatively, some have suggested that the lack of discrimination accuracy in high-stakes lies is due to stakes having a comparable influence on both liars and truth-tellers—both experiencing increased arousal and cognitive effort from wanting to be believed—suggesting that while there may be more cues present overall, they will be equally spread between the two veracities, nullifying their diagnostic value (DePaulo, 1992; Hartwig & Bond, 2014; Vrij, 2006). Currently, the results provide an interesting comparison of how stakes can impact decoder's accuracy, which do not align with the prevalent beliefs of the emotion-based approach.

A secondary aspect of the current experiment was investigating the importance of the emotional context of the lie told, as research rarely makes the distinction between the types of emotion that individuals are displaying when lying. The high-stakes videos used in the current experiment contained high-stakes emotional (HSE) and unemotional (HSU) videos, based on the type of emotions that the sender experienced during their lie. The results of the analyses revealed that accuracy for the HSE lies was higher than that of HSU lies, suggesting that the type of emotional information present in these lies had a significant impact on deception detection. Reclassifying the lies about the pleasant video as deceptive emotions (i.e. fabricated cues, of disgust), and the lies about the negatively arousing video as genuine emotions (i.e. leaked cues, from unsuccessful suppression of the underlying disgust) may help explain the source of the difference in accuracy. A growing body of evidence suggests that individuals are adept at producing deceptive emotional displays (e.g., Krumhuber & Manstead, 2009), but find it difficult to supress genuine emotions (Hurley & Frank, 2011). This distinction in terms of emotional cues is crucial, as it exemplifies how the recognition of such cues is only useful to deception detection if the decoder can also classify their authenticity (Zloteanu, 2015).

Liars may attempt to supress their emotions to hide their deceit, but this tends to be only partially successful in high (emotion) intensity scenarios (Ekman et al., 1988; Porter et al., 2012), resulting in leakage cues (i.e. displaying disgust in the HSE condition). Subsequently, liars may attempt to produce emotional displays to assist their lies which naïve decoders cannot perceive as deceptive. For example, Porter, ten Brinke, and Wallace, (2012) found that untrained observers could not discriminate between genuine and deceptive expressions beyond chance performance. In their study the presence of more leaked expressions in the high intensity condition also did not aid classification, suggesting that, for human decoders, intensity of emotion is not a factor.

Additionally, the current results suggest that genuine emotional cues, those reflecting the true affect of the deceiver, are generated from attempts to supress the emotions elicited by the stimulus they viewed (i.e. the gruesome surgery scene) and not the emotions generated by the stakes of the lie (e.g., fear of being caught) as the literature would predict. This suggests that increased stakes and increased arousal are not always synonymous, especially with regards to producing diagnostic cues to deceit, as is evidenced by the fact that HSU lies were not detected with the same accuracy. From this one could conclude that emotional cues relating to deception are primarily derived from the affect induced by the underlying truth and not by the stakes surrounding the success or failure of the lie.

***Emotion Recognition and Deception Detection.*** The inhibition hypothesis states that in high-stakes situations deceivers should experience increased arousal which results in increased leakage, such as emotional cues. A person that is versed in the recognition of such emotional cues should have an advantage in determining veracity.

Presently, the results suggest that training in facial expressions of emotions confers no benefit in detecting deception, for either high or low-stakes lies. These results seem to contradict past training studies reporting positive effects (Driskell, 2012; O'Sullivan et al., 2009), as well as emotion-based lie detection theories that predict an effect should have been seen for all high-stakes videos (Levine et al., 2005). It should be noted that the positive results of past emotion-based research were from correlations between individuals that are more adept at recognising emotions faring better at detecting deception (e.g., Matsumoto et al., 2014; Warren et al., 2009). Moreover, research training decoders specifically in non-verbal cues, as was done presently, reports worse deception detection accuracy compared to controls, suggesting that focusing on such cues can be detrimental to performance (Kassin & Fong, 1999; Mann et al., 2004). Currently it would seem that being given training in micro- and subtle expressions does not translate into improved classification of veracity.

Subsequently, the results also revealed that HSE lies were more accurately detected than HSU lies. This finding seems to be at odds with the result that ERT had no effect, as the difference in accuracy would suggest people do have an ability to use emotion information to accurately judge veracity. Then why did the training not improve emotional lie detection overall? One explanation may be due to people feeling overwhelmed by the amount of cues they needed to recall after what can be argued to be a brief and intense training period; however, a meta-analysis looking at the effect of training on nonverbal behaviour recognition found length of training to be unrelated to effectiveness (Blanch-Hartigan, Andrzejewski, & Hill, 2012), nor can it be argued that using students for decoders limited the effectiveness of training, as no difference in training outcome in microexpressions have been found based on decoder type (Hurley, Anker, Frank, Matsumoto, & Hwang, 2014).

It could be that the high volume of information may have made participants discount these cues entirely and use other sources of information. Alternatively, it may be that there is a difference between relying on one's implicit ability to recognise emotions and the explicit ability when detecting deception. Individuals may not be able to use the cues learned correctly, in real-time, as these go against their unconscious heuristics and stereotypical knowledge of deception cues (Akehurst et al., 1996; Malone & DePaulo, 2001; Zuckerman, Koestner, et al., 1981).

One caveat of the current methodology is that the training used was to increase the ability to recognise emotional cues in all scenarios, not specifically for deception detection (although the METT and SETT are marketed as such). Presently, I utilised general emotion recognition training instead of tailoring the cues taught to the current stimuli, such as coding the videos for the presence or absence of specific facial cues in each veracity, as any form of deception training should be generalizable—as emotions are argued to be a "universal" cue to deception. Moreover, past research suggests improvements from specific deception training do not generalize to other situations (see Blair, Levine, & Vasquez, 2015).

Also of importance is the fact that the bogus training condition (while not significant) produced the highest accuracy of all conditions, more so even than the actual training. This finding is in line with the suggestion by Levine et al. (2005) that even providing non-diagnostic training can produce effects, potentially due to the heightened vigilance and awareness that deception may be occurring. Including a bogus condition is clearly a necessary component of training studies.

Finally, the High-stakes videos were only classified as such due to the increased motivation to the liar, but this is not equivalent to real-world high-stakes where the consequences of being caught are severe (e.g., life in prison). In true high-stakes situations liar may produce more emotional cues that reflect leaked emotions, such as those in the HSE condition, which may be more diagnostic of deceit. However, this does not account for a lack of either a correlation or an effect of emotion recognition training on HSE lies and truths. A replication is warranted with the inclusion of real-world, high-stakes lies to fully understand the importance of emotion recognition and training in deception detection. Similarly, participants' ability to use emotional information from other channels, which may be more useful (DePaulo et al., 1983), was not trained. Future research can investigate if perhaps verbal emotional cues show a different pattern of results.

The current results are important as much focus has been placed on training police officers in nonverbal cues based on arousal and emotions (e.g., Inbau et al., 2011), which clearly seem to not facilitate deception detection. The present lack of an effect of training does not exclude the possibility that other forms of training can assist with deception detection, however, it does not support the claims made by the emotion-based approach.

**General Discussion**

In this chapter multiple core assumptions of the emotion-based approach were tested, to understand if these reflect actual veracity judgments made by decoders regarding emotional information. These were related to differences in decoders' ability to perceive and interpret brief facial cues (microexpressions and subtle expressions), the presence of such cues being directly related to stakes to the sender, and the lack of accurate knowledge decoders possess regarding such cues. Finally, that training in emotion recognition has beneficial results on detecting deception.

To understand the role of emotion recognition ability on veracity judgements Experiment 2 utilised low-stakes truths and lies, where emotion cues are said to be mostly absent. This approach allowed for an understanding of two important components of veracity judgements, as described by the emotion-based approach. Firstly, it tests the assumption that accuracy will be poorer in such scenarios due to the lack of behavioural cues decoders can utilise. Secondly, that emotion recognition ability has a positive relationship with decoding accuracy, which in such scenarios should result in either only a small or no improvement in accuracy. However, utilising a reinterpretation of the research on emotion recognition and deception detection, an alternative hypothesis was put forward: that emotion recognition is detrimental to the veracity judgement process due to decoders relying too heavily on such information and potentially misinterpreting deceptive emotional information as genuine. This was argued that the primary role of emotion recognition is to facilitate interpersonal communication, by appraising the emotions of others quickly, and not to analyse the underlying veracity of such emotions.

Experiment 2 illustrated the complex relationship between components of emotion recognition and deception detection. By looking at lies where emotion cues are believed to be scarce or absent it presented a unique opportunity to see how differences in the ability to recognise such cues influences the decision-making process in deception detection, separating accuracy from bias. The negative correlation between accuracy and empathy suggests that having high empathy is detrimental to veracity judgments, potentially due to the misinterpretation of deceptive emotional displays as being genuine. Conversely, less empathic individuals may have an advantage in determining veracity, as they potentially utilise cues, weigh information, and/or judge statements differently.

As the results do not reflect the proposed relationship between emotion recognition and deception ability with high-stakes lies, it suggests that this ability does not correlate linearly with deception, but that it is moderated by additional factors, such as the content of the lie. In contrast to previous explanations offered by the field, I consider that empathy does not reflect differences in the truth-bias, but a predisposition to facilitate social interactions, manifesting as an increased willingness to accept emotional information as being genuine (related more to the correspondence bias). This suggests that the relationship between emotion recognition and detecting deception should not be regarded as a detection sensitivity issues, where a better detector would be better at seeing the signals from the noise (as argued by the literature), but an issue regarding how the detected cues are interpreted by decoders.

By considering empathy and facial recognition as two separate but interconnected systems serving different purposes it may better explain the role that emotional information has on decoder's ability to detect deception. Facial expressions recognition requires quick processing of information and fast classification, the potential absence of such cues in the low-stakes stimuli resulted in no correlation with accuracy. Conversely, empathy may act as both a biasing component for deceptive emotional cues as well as hinder the processing of non-emotion related information also, as such information is given less importance or is processed to a lesser extent, resulting in poorer overall deception detection.

The limitation of Experiment 2 was the use of low-stakes lies only to test the biasing aspect of emotion recognition and accuracy. In Experiment 3, decoders were given both low and high-stakes lies and truths, as well as being provided training in emotion recognition to investigate emotion recognition in scenarios containing more cues. The role of emotion recognition training in deception is crucial as many have argued this to be a valid and highly successful method of achieving high accuracy. However, research on this approach has been scarce and has not produced sufficient support.

In Experiment 3 a replication of the finding of Experiment 2 was reported, with empathy showing a negative relationship with accuracy for low-stakes lies, but only a trend in this direction was seen for the high-stakes accuracy. This reaffirms that trait empathy serves a detrimental role in the process of accurately judging veracity. Subsequently, training in emotion recognition did not produce an improvement in detection, nor did it result in more biased or overconfident judgements. It appears that enhancing deception detection is difficult and may not improve through the use of emotion-based approaches. However, emotions clearly do influence detectability of deception as the high-stakes emotional lies were easier to classify than the unemotional lies. Either such lies contained a source of emotional cues that decoders could utilise to ascertain veracity, or the task of senders attempting to suppress their genuine emotional response elicited by the stimulus reduced the quality of their lies in some from. As it stands it is difficult to draw strong conclusions from this finding, however, they do partially support the leakage hypothesis. Additionally, it suggests a better conceptualization of the source of emotional cues as not being derived from the increased stakes of the lie (e.g., fear) but from the emotions elicited by the truth (stimulus specific). These results illustrate the importance of considering the source of emotion information in detecting deception.

In conclusion, emotions seem to play a complex role in deception detection. Facial cue detection was not found in any scenario to aid detection of deception, while empathy seemed to be negatively related to veracity judgements. Interestingly, the data suggests that human decoders may be unable to properly utilise emotional information to make rational veracity judgements, potentially due to an inability to discriminate genuine from deceptive emotional cues.

# Chapter 6: Deceptive Emotional Control – Senders' Ability to Fake an Emotion


## Abstract

The data suggests decoders are unable to utilise emotional cues to improve their veracity judgements, and that components of the emotion recognition system can negatively impact accuracy. An explanation proposed for this finding relates to the type of emotional cues senders produce, genuine and deceptive, and how these are processed. I argue that decoders do not benefit from using emotional cues in their decision-making as liars produce deceptive cues to aid their lying, which are indistinguishable from genuine cues. That is, decoders cannot ascertain the authenticity of emotional cues, reducing their diagnostic utility.

In two experiments, I investigated different methods of producing deceptive expressions of surprise, and their effect on decoders' ability to determine authenticity. In Experiment 4, senders were filmed while they experienced a genuine emotion: surprise at a vampire jack-in-the-box, or either while faking an expression of surprise directly (Improvised) or after initially experiencing genuine surprise (Rehearsed). Decoders then had to judge the authenticity of these emotions. It was found that decoders could not discriminate rehearsed from genuine surprise, but could discriminate improvised surprise. Experiment 5 separated the effect of rehearsing into its affective experience (i.e. internal feeling) and its physiognomic memory (i.e. external expression). In the Internal condition, senders utilised only the internal feeling of surprise to produce the deceptive expression, while in the External condition, senders used only the facial display of surprise to produce their expressions. Decoder found it harder to discriminate External surprise from Genuine surprise, although they found these to be subjectively less intense and genuine. The findings demonstrate that deceivers can convincingly produce deceptive emotional expressions, which decoders are unable to discriminate as inauthentic.

## Introduction

Genuine emotional expressions reflect the underlying affect of a person, while deceptive emotional expressions reflect the strategic intent of the sender in the absence of felt emotions. Deceptive expressions are a communication tool, with uses ranging from general social compliance to outright deception (Ekman & Rosenberg, 2005). Socially, they can be used to hide negative affect, prevent conflict or escalation, avoid hurt feelings, reassure, and gain trust (e.g., Hecht & LaFrance, 1998; Provine, 1997). Maliciously, deceptive expressions can be used to manipulate, deceive (Keating & Heltman, 1994), or mask true affect or intentions (Ekman & Friesen, 1982). Research finds that people when asked to pose facial expressions, without training, can easily fool observers with their performances (Gosselin, Perron, & Beaupré, 2010; Gunnery, Hall, & Ruben, 2013; Krumhuber & Manstead, 2009).

Few studies have focused on people's ability to infer the veracity/authenticity of emotional cues, most focusing on differences between recognising genuine versus posed smiles. Prior research has shown that people can recognise emotions from both posed and genuine congruent facial expressions, but only ascribe affect to genuine expressions (Frank et al., 1993; Johnston, Carter, & McLellan, 2011; Johnston, Miles, & Macrae, 2010; Miles & Johnston, 2007). However, deception research has shown that people are poor at detecting veracity based on emotions (Ekman & Friesen, 1974; Ekman & O'Sullivan, 1991; Hess & Kleck, 1994), finding that people have difficulty detecting simulated emotions, but show some ability in discerning masked and supressed emotions (Soppe, 1988).

Empirically, deceptive expressions are found to differ from genuine expressions based on: (i) lack of "reliable" facial muscles, which activate only during felt emotions (Ekman, 2003a; but, see Krumhuber & Manstead, 2009), (ii) intensity of presentation; either reduced, as deceptive expressions are absent of the underlying affect (Hess, Banse, & Kappas, 1995; Hess, Blairy, & Kleck, 1997), or increased, due to the deceiver's attempts to clearly communicate the information, overexpressing the emotion (Conson et al., 2013), (iii) absence of the physical signs of arousal that accompany a genuine emotional state, such as pupil dilation (Levenson, 2014), and (iv) asymmetrical appearance (Ekman, 2003a), potentially due to their production relying on a different neural pathway than genuine expressions (Carr, Korb, Niedenthal, & Winkielman, 2014; Ekman, Roper, et al., 1980).

While cues of authenticity seem to exist, people still do not show great accuracy in discriminating deceptive from genuine expressions. A possible explanation for the varied results is the lack of separation of different types of expressions. The umbrella term of "posed" expressions obfuscates the difference in expression production, and ignores differences in their appearance and perception. The classical "posed" expressions are voluntary productions of an emotional display resulting from specific instructions (Ekman, Levenson, & Friesen, 1983; Reisenzein & Studtmann, 2007; Russell, 1994). "Portrayed expressions" are spontaneous deceptive expressions that occur in the absence of explicit instructions but are congruent with the context in which they occur, such as smiling for a photograph. "Mocked expression" are deliberate deceptive expressions used to facilitate communication and learning (Chong, Werker, Russell, & Carroll, 2003). "Masked expressions" are appropriate displays of emotions hiding an incongruent emotion that the deceiver is actually experiencing (Ekman, 2003a). Finally, "enacted expressions" are expressions voluntarily produced after reliving a congruent past experience of the emotion (see Scherer & Bänziger, 2010). The different productions can influence how a decoder perceives the expression, and how well they can classify their veracity (for a comprehensive review of different posed expressions and methods of eliciting them, see Coan & Allen, 2007).

Presently, I examined the effect that the method of producing deceptive expressions on their perception of authenticity, focusing on the surprise expression. Surprise is considered one of the basic emotions, having a distinctive facial configuration that is well recognised cross-culturally (Nelson & Russell, 2013). Unlike other basic expressions, it is considered to have a neutral valance or one determined by individual interpretation of an experience (Ekman, 2004). Past research has reported issues eliciting surprise (e.g., Ludden, Schifferstein, & Hekkert, 2009; Reisenzein, 2000; Vanhamme, 2000), however, I considered these issues may be due in part to not using the appropriate elicitation scenarios, i.e. predominantly utilising disconfirmation of expectation or unexpected events (e.g., Reisenzein, Bördgen, Holtbernd, & Matz, 2006). I believe the surprise expression is more closely related to the startle response, the sudden defensive response to an external aversive stimulus. For example, Schützwohl and Reisenzein, (2012) failed to elicit the full surprise expression using the disconfirmation of expectation approach (achieving this only 5% of the time), as their participants felt more 'irritated' or 'astonished' by the procedure than startled. By utilising a startling scenario the elicitation of the prototypical expression of surprise may be improved. To achieve this I used a vampire jack-in-the-box (Figure 11).

Figure 11. Stimulus used to elicit the surprise emotion, a vampire jack-in-the-box.

**Experiment 4: Rehearsed vs Improvised**

An important aspect of deceptive emotional production is the difference between an expression derived from previous experience compared to one based on no/minimal information (see Ekman et al., 1983). For the former, as the sender is not given specific instructions (i.e. which muscles to activate), but is reliving a genuine emotional experience, it may facilitate the production of an authentic looking deceptive display (see scenario re-enactment approaches; Bänziger & Scherer, 2007, 2010). Conversely, improvising an expression may produce a more successful deceptive display as it reflects a gestalt belief of the surprise expression that may better match the expectations of the decoder (e.g., Elfenbein et al., 2007). Thus, does the experience of surprise results in a more genuine-looking deceptive expression or does one based on the sender's own beliefs?

To investigate this difference I utilised a simple methodology: participants performed a deceptive expression of surprise (one that was absent of feeling, but aimed at convincing an observer that it was genuine), either in response to a neutral stimulus (Improvised) or recreating the expressions after having experienced genuine surprise, using a jack-in-the-box (Rehearsed). It was hypothesised that the deceptive expressions produced through improvisation will be perceived differently than those produced through the attempted reproduction of genuine expressions. Additionally, these may differ in how they are classified by decoders when compared to genuinely produced expressions of surprise.

## Methods

### Stimuli Creation

***Participants.*** 39 individuals (12 male, 27 female) were recruited using UCL's Online Subject Pool in return for course credit; none were trained actors or had any previous emotion training. I used untrained individuals as the expressions actors generate may reflect trained, stereotypical beliefs about emotions and desire to make the performance transparent (i.e. producing intense caricatures of emotions), while missing the subtler aspects of a genuine expression. Informed consent and rights to use the recordings was obtained from all subjects.

***Design and Procedure.*** A between-subjects design was employed, with Production Method (Genuine, Rehearsed, or Improvised) being the independent variable. The manipulation was the order in which participants saw the jack-in-the-box and had to perform the genuine and deceptive facial expressions (Genuine, Rehearsed, or Improvised). The reactions to the stimulus of 13 individuals were recorded in each condition.

The stimulus was a vampire jack-in-the-box, with a melody that would cue the moment the jack would jump out. In the Genuine condition, participants sat in front of the box and cranked the wheel until the jack 'popped out'; their reaction was recorded (from the start of the action, to the onset of the expression, until it terminated). Participants in the Improvised and Rehearsed conditions also operated the jack-in-the-box crank, in the absence of it being operational, to ensure the actions recorded were as closely matched as possible. In the Rehearsed condition, participants were recorded while first performing the same actions as the Genuine group, and afterwards watch a video of a countdown, with the same melody playing in the background, and reproduce their previous expression when the word "NOW" appeared on screen. The countdown was matched for time and volume with the jack-in-the-box. In the Improvised condition, participants were recorded only seeing the neutral countdown and being told to act surprised when they saw the word "NOW" flash on screen.

**Stimuli Presentation**

***Participants.*** 43 participants (23 male, 20 female), with $\text{Mean}_{\text{Age}} = 29.5$ ($SD = 7.5$), were recruited through Amazon Mturk. They were each paid $0.75 for their participation. Informed consent was received from all participants.

***Stimuli.*** This study utilised dynamic stimuli (videos) instead of static expressions, as past research has highlighted their superiority and ecological validity for discriminating authenticity (Ambadar, Schooler, & Cohn, 2005; Gosselin, Perron, Legault, & Campanella, 2002; Krumhuber & Manstead, 2009; Wehrle, Kaiser, Schmidt, & Scherer, 2000). 13 videos were created for each condition, Rehearsed (5m, 8f), Improvised (3m, 10f), and Genuine (4m, 9f). All videos are without sound, and approximately the same length (around 10s).

***Design and Procedure.*** A within-subjects design was used, where all video conditions were presented to all decoders (Genuine, Rehearsed, and Improvised). Decoders were measured on several factors. Firstly, accuracy in classifying the expressions as either being produced genuinely or deceptively (i.e. authenticity discrimination). Secondly, perceived genuineness of an expression. Genuineness can be a subjective rating of accuracy or it may reflect the ability of the sender to display anticipated stereotypical cues of an emotion (Mehu, Mortillaro, Bänziger, & Scherer, 2012). Thirdly, intensity of the expression, as this is considered relevant to authenticity (Hess et al., 1997). Confidence ratings were taken to understand if decoders have an awareness of their ability to discriminate authenticity.

Participants were provided with a link to a Qualtrics questionnaire containing the videos (Version 45634 of the Qualtrics Research Suite, Copyright ©, 2013). Demographics and mood were initially recorded. Studies on facial expression recognition have found that mood can affect classification accuracy, therefore it was considered prudent to control for this factor. Participants saw each video, randomly presented, and had to identify if they believed the expression seen was produced while the actor saw a jack-in-the-box or without seeing it, using a 5-point scale ranging from “Certain NO Jack-in-the-box” to “Certain WITH Jack-in-the-box” , followed by ratings of confidence, and the intensity of the surprised expression, using a 5-point scales. At the end all participants were fully debriefed.

**Results**

As preliminary analyses indicated that the reported effects do not differ between males and females, all subsequent analyses were conducted after collapsing across gender. The ratings of the videos were analysed based on Production Method to assess whether participants were able to distinguish deceptive from genuine expressions of surprise, and for differences in how these were perceived.

Investigating how genuine the expressions appeared to decoders, the raw responses from the question “What did you think of the expression?”, with responses ranging from “Certain with Jack-in-the-box” to “Certain without Jack-in-the-box” were analysed based on condition. This measure is equivalent to responses in deception studies asking the perceived honesty of the sender. The ratings given for each expression were taken as a value for how genuine the expression was perceived (i.e. ratings >0 represent a more genuine expression, while ratings <0 represent the expression being perceived as more deceptive; range ±5). Participants rated the Genuine videos as highly genuine (which serves as a manipulation check), followed by Rehearsed which were rated lower but still above 0, and then Improvised which were rated below 0, indicating they were generally perceived as deceptive. Analysing the data revealed a significant difference of video condition on perceived genuineness, $F(2,84) = 40.02$, $p < .001$, $\eta_p^2 = .488$. Subsequent tests revealed that Rehearsed expressions were rated significantly more genuine than Improvised expressions, $t(42) = 4.80$, $p < .001$, 95% CI [1.60, 3.93], $d = 1.48$, while both deceptive conditions were rated significantly less genuine than the Genuine expressions, $t(42) = 4.62$, $p < .001$, 95% CI [1.91, 4.88], $d = 1.43$, $t(42) = 8.27$, $p < .001$, 95% CI [4.66, 7.67], $d = 2.55$ (see Figure 12).

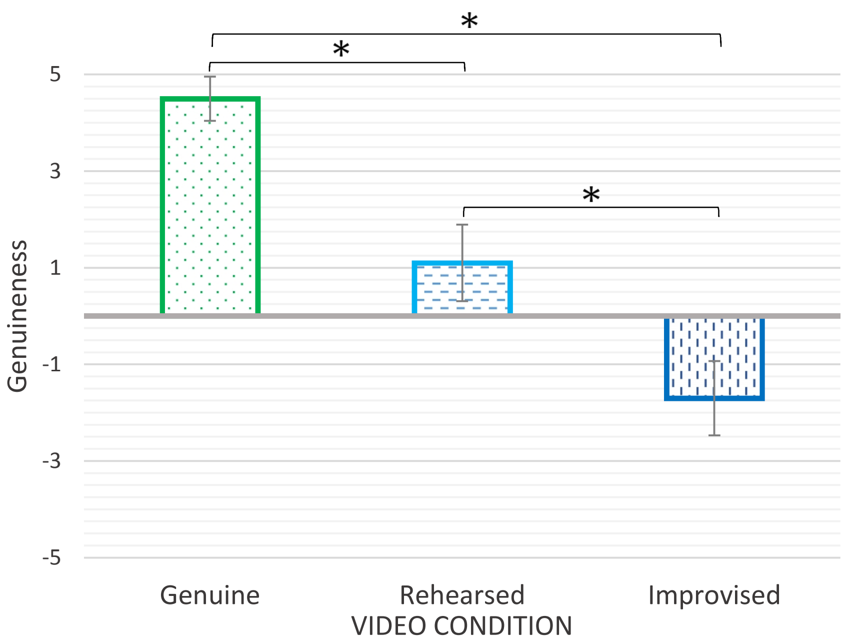


Figure 12. Mean ratings indicating if the expressions were perceived as more or less genuine (error bars indicate ± 1 SE); positive values represent that the expression was perceived as more genuine, while negative that it was perceived as faked. The asterisks represents a significant difference at $p < .001$.

To determine decoders' authenticity discrimination ability the scale used to assess perceived genuineness was recoded as: Lie, Unknown, True. These scores were compared to the actual veracity of the expression to formulate an accuracy score (e.g., if a deceptive expression was scored by participants as a Lie it was marked as correct). To aid interpretation these are reported as percentage scores for each condition, which resulted in 62.62% (*SD* = 19.82) for Genuine, 48.7% (*SD* = 19.27) for Improvised, and 38.54% (*SD* = 19.82) for Rehearsed videos. Analysing the results using a repeated-measures ANOVA revealed a significant effect of video condition on accuracy, $F(1.41,84) = 24.31$, $p < .001$, $\eta_p^2 = .367$ (as Mauchly's test indicated that the assumption of sphericity had been violated, $X^2(2) = 22.73$, $p < .001$, a Greenhouse-Geisser estimates of sphericity ($\varepsilon$= 0.70) correction was applied).

Subsequent repeated measures t-test were conducted (Bonferroni corrected) to assess the difference between conditions. It was revealed that there was a significant difference between Genuine and Rehearsed, $t(42) = 5.78$, $p < .001$, 95% CI [1.99, 4.14], $d = 1.78$, Genuine and Improvised, $t(42) = 3.74$, $p = .001$, 95% CI [.84, 2.79], $d = 1.15$, and Improvised and Rehearsed, $t(42) = 4.71$, $p < .001$, 95% CI [.72, 1.79], $d = 1.45$. The Rehearsed expressions were hardest to detect as deceptive, while the Improvised were easier to classify, but still not as easy as the Genuine expressions (Figure 13).

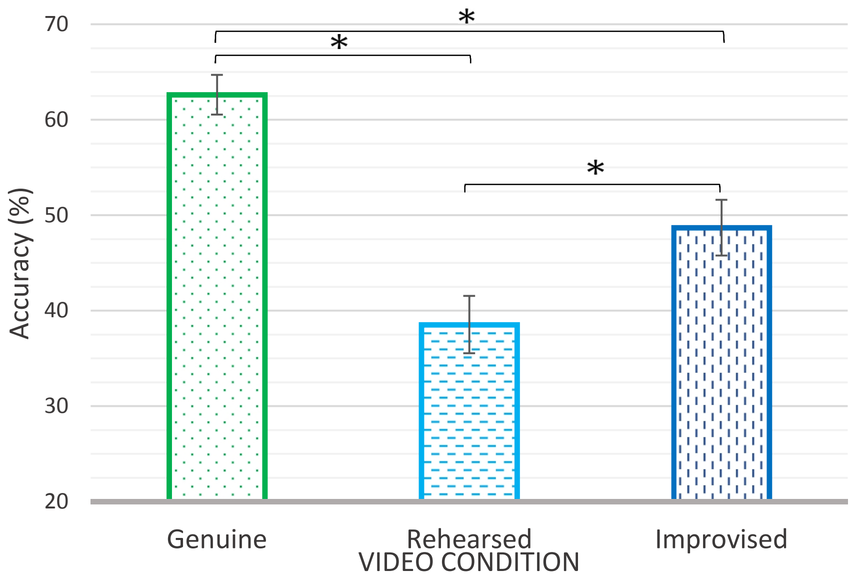


Figure 13. Mean accuracy scores for correctly discriminating the expressions as genuine or deceptive (error bars indicate ± 1 SE); the asterisks represent significance at $p < .001$.

There was a main effect of video condition on confidence, $F(2,84) = 10.65$, $p < .001$, $\eta_p^2 = .202$. Decoders were less confident for the two deceptive conditions, Rehearsed and Improvised, compared to the Genuine condition, $t(42) = 4.13$, $p < .001$, 95% CI [1.70, 4.95], $d = 1.28$, $t(42) = 3.76$, $p = .001$, 95% CI [1.14, 3.79], $d = 1.16$, while the two did not differ from each other, $t(42) = 1.11$, $p = .27$, 95% CI [-.70, 2.42], $d = 0.34$ (see Figure 14).

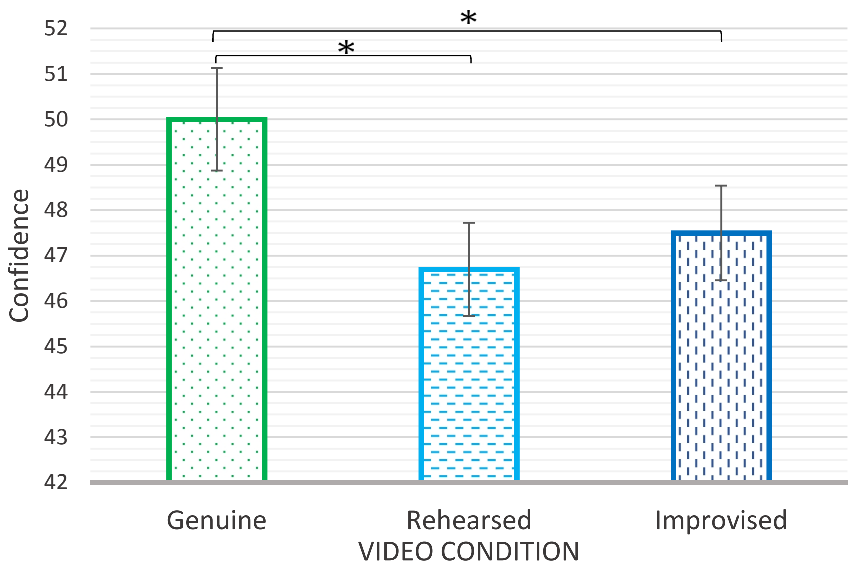


Figure 14. Mean confidence ratings per video condition (error bars indicate ± 1 SE). The asterisks represents a significant difference at $p<.001$.

The intensity rating for each expression were also analysed to uncover differences in perception based on production method. There was an overall effect of video condition on ratings of intensity, $F(1.37,84) = 32.28$, $p < .001$. $\eta_p^2 = .435$ (Greenhouse-Geisser correction). Subsequent results revealed that the two deceptive expression conditions were rated significantly less intense than the Genuine condition for Rehearsed, $t(42) = 6.63$, $p < .001$, 95% CI [3.61, 6.77], $d = 2.05$, and Improvised, $t(42) = 5.57$, $p < .001$, 95% CI [3.16, 6.75], $d = 1.72$,. Both deceptive conditions did not, however, differ significantly from each other, $t(42) = .54$, $p = .59$, 95% CI [-.64, 1.10], $d = .17$, see Figure 15.

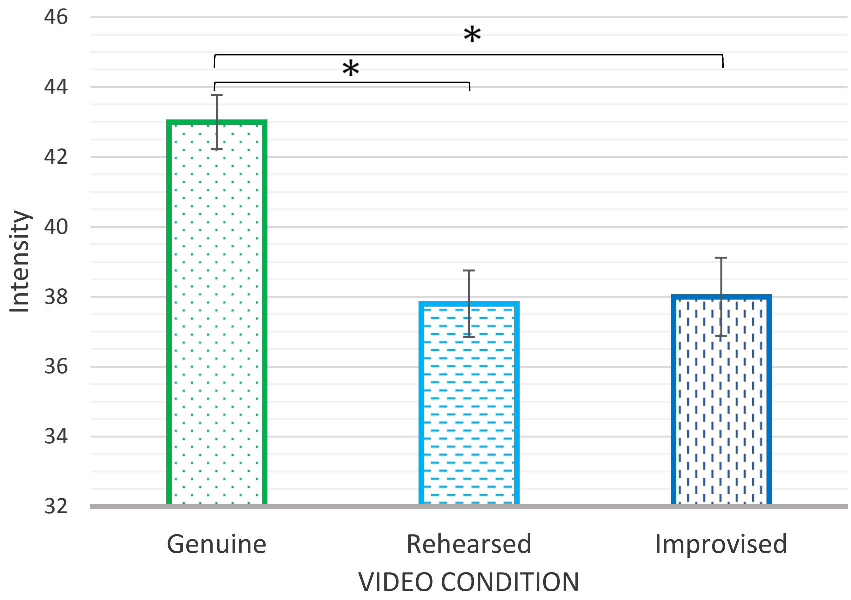


Figure 15. Mean differences in perceived intensity of surprise based on facial expression condition (error bars indicate ± 1 SE). The asterisks represents significance at $p < .001$.

**Discussion**

The result indicate that production method of the deceptive expressions influenced their perception and how easily they were detected as reflecting authentic affect. Participants displayed lower accuracy in detecting rehearsed expressions as deceptive, compared to those that were improvised, however, all deceptive expressions were perceived as less intense and genuine in appearance compared to authentic expressions. This suggests that decoders were able to identify subtle differences in expression appearance, but these did not translate to improved classification accuracy. Overall, the results suggest having a recent experience with actual surprise allows deceivers to convincingly fake the expression at a later time.

**Experiment 5: Internal and External**

The above study demonstrated that a recent emotional experience allows a deceiver to convincingly portray the same expression in the absence of affect (i.e. deceptively).

However it does not identify which aspect of this recent experience is improving the deceptive performance. That is, for the deceptive expression to appear genuine does the liar require the memory of the genuine affective state or simply the muscle memory of the facial display that was previously activated?

To separate these two processes I drew inspiration from two well-known acting methods, the Mimic (External) and the Stanislavski (Internal) method. The Mimic method believes emotions can be genuinely reproduced by mimicking the behaviour of individuals that are actually experiencing an emotion. The deceiver only needs knowledge of the display that corresponds to the genuine emotions for them to convincingly portray it; however, certain aspects of an emotional display are difficult to voluntarily control in the absence of true affect (Mehu et al., 2012). This approach is reflected in the field of facial mimicry and emotion contagion (Hatfield, Cacioppo, & Rapson, 1994; Hess & Fischer, 2013; Keysers & Gazzola, 2009). It suggests that viewing an expression provides sufficient information to activate the appropriate neural structures in the observer, allowing them to understand the display and its related affective state. Such research argues that direct experience with the emotion is not necessary, as the observer can simulate the specific state internally and then reproduce it at will (i.e. mentalistic simulation; Dunn, 2000). While this does not discount the mechanism of regular mimicry of behaviour (i.e. simply reproducing behaviour in the absence of emotional simulation), it does suggest how such a nuanced and complex behaviour, such as a facial expression, can be reproduced with minimal information.

Alternatively, The Stanislavski method considers that emotions can only be posed successfully by recalling a previous affective episode (Hull, 1985). A successful deceiver needs to recall a memory that is congruent with the genuine emotion they wish to portray, simulating affect more naturally. This approach reflects the mentalizing approach to interpreting emotions, where the liar relies on a past affective episode to elicit the correct emotion in themselves, allowing for a cognitive-affective re-enactment of the associated affective display (see embodied simulation; Gallese, 2003; Niedenthal, Barsalou, Ric, &

Krauth-Gruber, 2005). Embodied simulation is generally used to explain how we understand the emotional states of others, however, presently it can be used to understand how deceivers may utilise affective simulations to recreate the necessary behavioural markers to deceive. However, the remembered expressions may not be intense enough for it to appear genuine (Ekman et al., 1983) or contain the correct facial muscle activation (Reisenzein et al., 2006).

It was predicted that experiencing the internal sensation of surprise compared to its external appearance will affect how the deceptive expression is perceived and accurately detected based on authenticity.

## Methods

### Stimuli Creation

***Participants.*** 39 individuals (13 male, 26 female) were recruited using UCL's Online Subject Pool. All participants received course credit for their participation. Informed consent and rights to use their recorded videos was obtained from all participants.

***Design and Procedure.*** A between-subjects design was employed. The independent variable was the method used to produce the facial expression of surprise (Genuine, Internal, or External). All participants recorded a faked emotion using the same procedure and apparatus as Experiment 4, but manipulated regarding their 'internal' or 'external' information available to help them. The same jack-in-the-box and neutral countdown were utilised. In the internal condition the procedure was similar to that of Experiment 4's Rehearsed condition, however, while participants initially experienced the genuine surprise expression, using the jack-in-the-box, they were instructed to actively supress any behavioural reaction, such as a facial expression or verbalisation[4]. Then they were instructed

[4] This approach has been used successfully in the past to restrict facial movement, however, it has also been shown to influence facial feedback (a component of experiencing emotions fully). This could be argued to reduce the sensation the liar has to draw upon later (Stel, Van Baaren, & Vonk, 2008). The decision was made as alternatives (e.g., asking participants to recall a surprising event) would have produced additional extraneous variables (such as differences in eliciting event, intensity, valence of event), as well as research indicating that such attempts are not generally successful (Reisenzein, Bördgen, Holtbernd, & Matz, 2006).

to recollect that internal state experienced while recording the deceptive expression towards the neutral countdown. For the External condition, participants first viewed a recording of another participant from the Genuine condition in Experiment 4 (randomly selected) and were told to study the reaction. Afterwards, they were recorded recreating the expression they had seen while watching the neutral countdown.

**Stimuli Presentation**

***Participants.*** 50 participants (14 male, 36 female), with $Mean_{Age} = 25$ (*SD* = 7.2), were recruited through Amazon Mturk. They were paid the same amount as in Experiment 4.

***Stimuli.*** 13 videos were created for each condition, Internal (5 male, 8 female), External (3 male, 10 female), and Genuine (using the videos from Experiment 4).

***Design and Procedure.*** The design and procedure were identical to Experiment 4, the only difference being the video conditions presented (Genuine, Internal, or External).

**Results**

The responses to the videos were analysed based on video condition for differences in the ability to determine expression veracity. Results were collapsed over gender, as no significant differences were found in preliminary analyses.

To understand if the method deceivers produced emotions influenced their perception, the analysis on perceived genuineness was conducted. It revealed that there were perceivable differences between the three experimental conditions, $F(2,98) = 48.87$, $p < .001$, $\eta_p^2 = .499$. Genuine expressions were perceived the most real, followed by External which were rated positively, and by Internal expressions, which were rated negatively (Figure 16). Subsequent tests revealed that External surprise was rated as more genuine than Internal surprise, $t(49) = 3.54$, $p = .001$, 95% CI [.86, 3.14], d = 1.01, while both deceptive conditions were rated lower than Genuine expressions, $t(49) = 8.58$, $p < .001$, 95% CI [4.76, 7.67], $d = 2.45$, and $t(49) = 6.73$, $p < .001$, 95% CI [2.96, 5.48], $d = 1.92$.

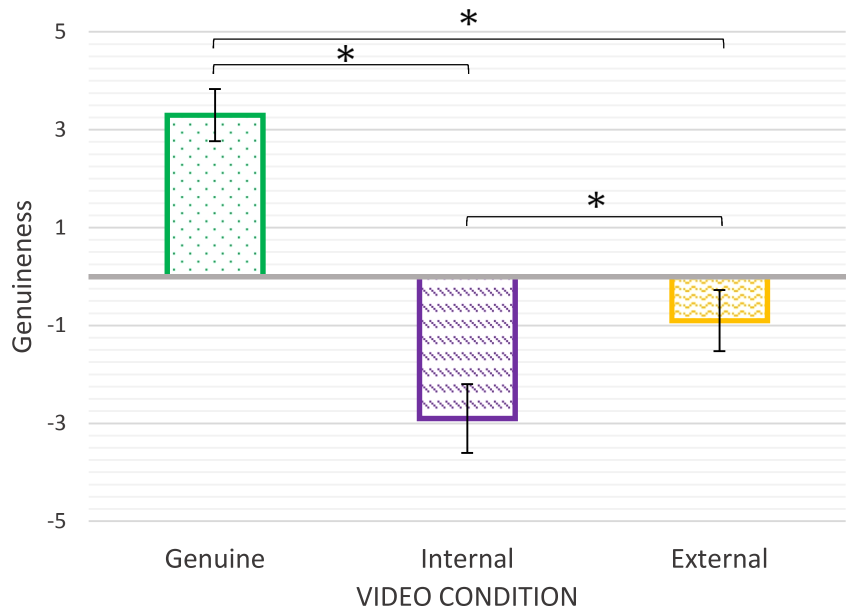


Figure 16. Mean ratings of genuineness based on video condition (error bars ±1 SE). The asterisks represent a significant difference at $p < .001$.

The overall accuracy scores for detecting the correct veracity of the expression were converted into percentages for easier understanding. The Genuine condition had a detection accuracy of 58.31% (*SD* = 16.31), the Internal condition had 55.7% (*SD* = 20), and the External condition had 47.4% (*SD* = 19), indicating that the most successful deceptive expressions were the ones utilising the mimicking technique.

To see if these differences were significant a repeated-measures ANOVA was conducted, revealing an overall effect of production method on accuracy, $F(1.47,98) = 5.14$, $p = .015$, $\eta_p^2 = .095$. Subsequent repeated-measures t-tests (Bonferroni corrected) revealed that there was a significant difference between Genuine and External expressions, $t(49) = 2.69$, $p = .01$, 95% CI [.36, 2.48], $d = 0.77$, and between Internal and External expressions, $t(49) = 3.71$, $p < .001$, 95% CI [.50, 1.67], $d = 1.06$, but not between the Genuine and Internal expressions, $t(49) = .65$, $p = .522$, 95% CI [-.64, 1.40], suggesting that External surprise was harder to accurately identify as deceptive (Figure 17).

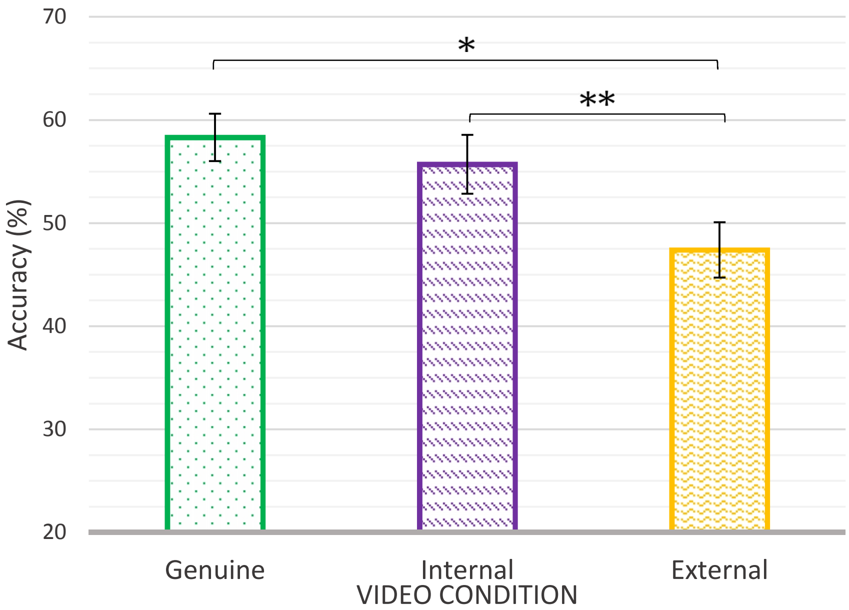


Figure 17. Accuracy rates for detecting if the expressions seen were genuine or deceptive (error bars indicate ± 1 SE). The asterisks represent significance, *$p < .01$ and **$p < .001$.

Subsequently, confidence ratings were analysed revealing a significant overall effect of production method, $F(2,98) = 21.02$, $p < .001$, $\eta_p^2 = .300$. The results show that decoders had reduced confidence in their discrimination ability for the Internal and External conditions, compared to the Genuine condition, $t(49) = 5.07$, $p < .001$, 95% CI [1.74, 4.02], $d = 1.45$, and $t(49) = 5.80$, $p < .001$, 95% CI [2.35, 4.85], $d = 1.66$, but showed no difference in confidence between the two deceptive conditions, $t(49) = 1.26$, $p = .214$, 95% CI [-.43, 1.87] (see Figure 18).

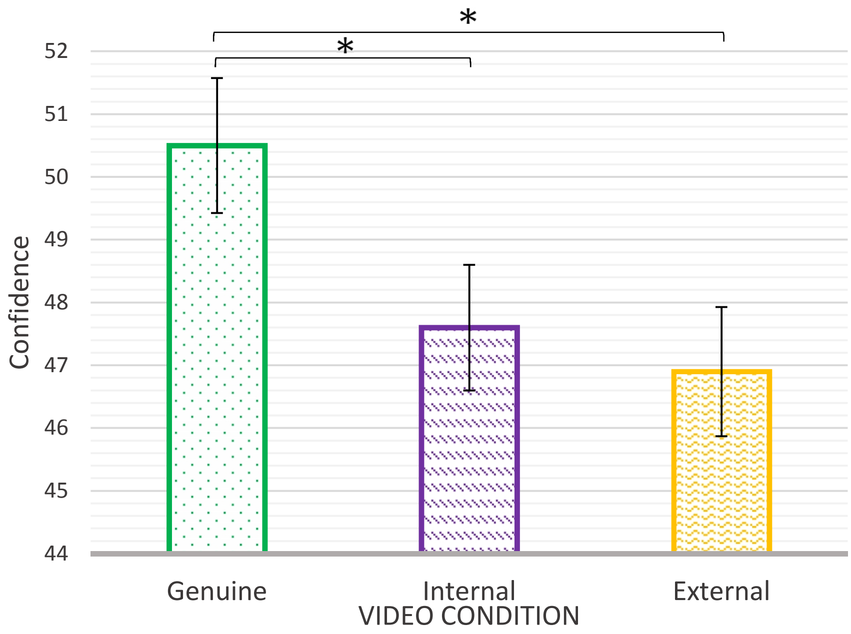


Figure 18. Mean confidence ratings per video condition, bars represent a difference from Genuine for Internal and External videos (error bars ± 1 SE). The asterisks represent significance at $p < .001$.

Finally, ratings of intensity of facial expressions were analysed. Overall perceived intensity differed based on condition, $F(2,98) = 35.09$, $p < .001$, $\eta_p^2 = .417$. External surprise was rated as more expressive than Internal surprise, $t(49) = 6.46$, $p < .001$, 95% CI [2.74, 5.22], $d = 1.85$, External surprise was rated equally expressive with Genuine surprise (non-significant after Bonferroni corrected), $t(49) = 2.26$, $p = .028$, 95% CI [.16, 2.68], while Internal expressions were rated less intense than Genuine expressions, $t(49) = 7.17$, $p < .001$, 95% CI [3.89, 6.91], $d = 2.05$. This demonstrates that supressing the facial expression of surprise had an effect on intensity during reproduction (Figure 19).

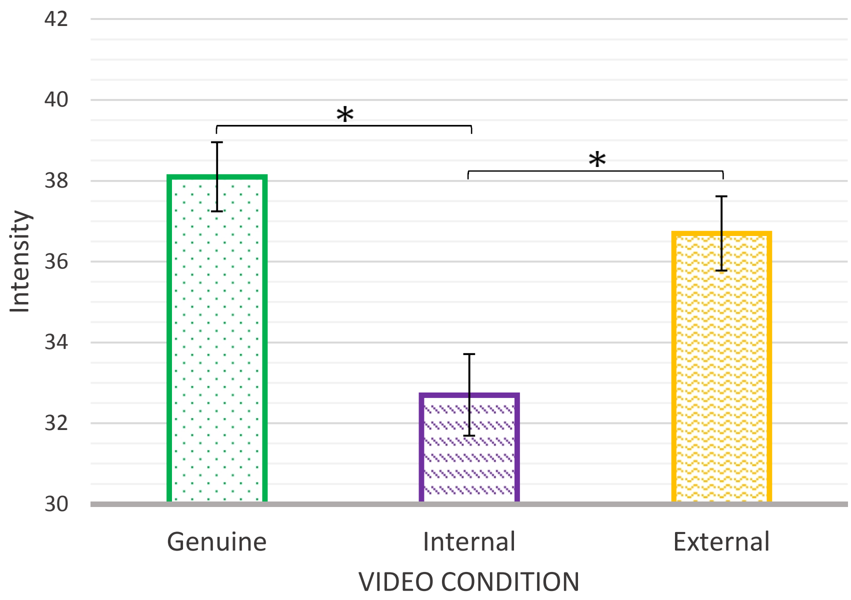


Figure 19. Mean ratings of perceived intensity based on facial expression condition (error bars indicate ± 1 SE). The asterisks represent significance at $p < .001$.

**Discussion**

The results support the Mimic method of producing genuine-looking deceptive expressions, as External surprise was harder to accurately classify as deceptive and was rated as more genuine and intense than Internal surprise. However, both deceptive conditions were rated as less genuine in appearance compared to genuine surprise. It seems that having knowledge of the genuine surprise display (i.e. facial mimicry) is more important than having the memory of the internal sensation when it comes to reproducing the expressions successfully (i.e. embodied simulation).

**General Discussion**

The central aim of the current chapter was to understand if deceptive emotional expression can be produced by senders, and the mechanisms that may best capture such expressions. The experiments presented focused on the method of producing a deceptive expression, attempting to identify how this would influence decoders' perception of the expressions and their ability to discriminate its authenticity. This was an important component of the argument put forward in this thesis, because, if production of deceptive expressions can be easily achieved by liars it could explain why the emotion-based approach to detecting deception has been found to be so unsuccessful. Subsequently, if decoders are unable to separate genuine from deceptive emotional displays, then the ability to recognise emotional cues (e.g., facial expressions) would not serve deception detection. Furthermore, as seen in Chapter 5 incorrect interpretation of emotional information can result in decreased accuracy (i.e. judging deceptive expression as genuine).

Experiment 4 found that having a recent genuine experience of surprise allowed deceivers to convincingly produce the emotional expression afterwards; the poor detection indicating that decoders believed the deceptive sender was being genuine. This was not found for the improvised expressions, which were rated as low in both expressivity and genuineness. For senders, this suggest that relying on your own stereotypical beliefs about emotional expressions, in the absence of additional information, will not produce an expression that appears genuine. Conversely, if senders have prior recent knowledge with the way an emotion feels and is displayed, replicating the emotion will be successful enough to convince decoders.

Experiment 5 separated the effect of the rehearsal into its internal component—the feeling of surprise—and its external component—the physical expression of surprise. It was found that senders were more successful at producing deceptive expressions when drawing on the external appearance of the emotion, than the internal sensation. While decoders were able to distinguish both deceptive expression from genuine surprise the method of production influenced perceptions of intensity, genuineness, accuracy of discrimination, and the confidence in this decision. Interestingly, External expressions were not as difficult to classify as were the Rehearsed expressions in Experiment 4, suggesting that both the internal and external aspects of a rehearsal are beneficial for recreating expressions successfully, potentially due to having more information to use, freeing up production resources.

While it is difficult to determine the exact reason for the difference between the External and Internal conditions a few explanations can be considered. In the Internal condition, recalling the memory of an emotion while attempting to control the nonverbal channels to produce an expression may have resulted in increased cognitive load for the senders, hindering the deceptive performance (see Vrij, Fisher, et al., 2006). The superiority of the external expressions is supported by past research, as mimicry research has shown that viewing genuine smiles results in increased production of genuine smiles, while viewing posed smiles results in more posed smiles (Lundqvist & Dimberg, 1995), suggesting that the reference expression affects the facial muscles activated. Improvising an expression requires more conscious processing, such as imagining the emotions and the correct presentation, deciding when to perform it and for how long. The results of Gunnery and colleagues (2013) support this interpretation, as they also found that imitating lead to increased Duchenne smiles, compared to role-playing (using their memory to produce the expression). Their results suggest that senders have significant control over facial display production, and that imitating is an easier cognitive task than producing an insincere expression while in the act of actively deceiving.

Another interesting result of the current data is that external expressions were perceived as more intense than internal expressions, which may have influenced decoders in classifying the expressions (incorrectly) as genuine. Past research has argued that expression intensity is a marker for emotional authenticity (Russell, 1994). If this is a lay belief about facial expression authenticity, then liars producing intense caricatures of facial expressions will be more successful in their deception. However, here the data indicates that only senders that witnessed a genuine expression could "match" intensity more closely, suggesting that relying on mimicry of emotions is more reliable than attempting to re-enact an emotional expression. This may also reflect the methodology employed, as restricting facial movement during the actual experience of surprise in the Internal condition may have reduced the experience of surprise (i.e. restricting facial feedback; Stel, Van Baaren, & Vonk, 2008).

Interestingly, and related to the above, the deceptive expressions in Experiment 4 were perceived as less intense than their genuine counterparts. This is surprising, as the literature on facial expression production has suggested that voluntary expressions should be more intense, due to senders wanting their message to be clear, and the reliance on stereotypical beliefs of how an expression should look, producing caricaturised version of the genuine emotion. The study by Krumhuber and Manstead (2009), for example, also reported that 'deceptive' Duchenne smiles, from participants in their posed condition, displayed expression that were *more* intense. It could be that there are differences between how a perceiver judges the expression, and how it would be categorised if it was coded objectively for facial muscle activation. However, currently facial intensity did not relate to the perception of genuineness or accuracy. Furthermore, in Experiment 5, the External expressions were perceived equal in intensity to the genuine expressions, however, they were not rated more accurately than those in the Rehearsed condition of Experiment 4. Currently, the results are consistent with findings that genuine expressions are perceived as more intense and genuine in appearance than posed expressions (e.g., Gosselin, Beaupré, & Boissonneault, 2002; Gosselin, Perron, et al., 2002), however this does not seem to aid authenticity discrimination.

The combined results of the two experiments support my assertion that liars can easily produce deceptive emotional displays in the absence of genuine affect, even by simply reproducing the external representation of a genuine facial display. Furthermore, it supports the results presented in the previous chapters, demonstrating that the emotion-based approach to detecting deception does not fail (only) because decoders have no cues (verbal, nonverbal, or paraverbal) to utilise, but because even the emotional cues (i.e. facial displays) they do recognise are not always classified correctly. The implication of these findings span beyond the deception literature, as they demonstrate a control of emotional cue production that has not been properly addressed in the emotion literature thus far.

***Implications for the Emotion Literature.*** As discussed in the introduction of this chapter and Chapter 2 and 3, emotions play an integral role in communication and social interactions. Moreover, humans are very adepts at recognising the meaning behind various emotional displays, being able to infer the affective state of the sender and predict their intentions and future actions; however, this research has predominantly focused on intended emotional cues. At present, the results reaffirm that humans possess an in-built mechanism that is finely tuned for recognising emotions from specific muscle-pattern activation (as seen from Experiment 2's METT and SETT scores, and Experiment 4 and 5 recognition of genuine surprises). However, the results demonstrate that they do not possess a refined mechanism for separating genuine expressions from those produced with the explicit purpose of misleading the receiver. While it has been suggested that, objectively, there are behavioural differences between genuine and deceptive expression (Mehu et al., 2012), the results presented here suggest that individuals can produce expressions that bear the hallmarks of genuine expressions (e.g., Gunnery et al., 2013; Krumhuber & Manstead, 2009), enough to fool decoders.

The findings of Experiment 4 and 5 open up avenues for future research, especially relating to behavioural markers that separate spontaneous from voluntary expressions. As found in the neuropsychological literature, there exist two neural structures in the brain that control facial displays relating to emotions, a voluntary and an involuntary pathway (Kahn, 1964; Mcgovern & Fitz Hugh, 1956; Miehlke, Fisch, & Eneroth, 1973; Myers, 1976; Tschiassny, 1953). This has been confirmed from lesion studies, finding that patients with lesions in the pyramidal system have difficulty producing deliberate facial expressions but are able to spontaneously display expressions in response to affective stimuli, while patients with lesions in the non-pyramidal systems results in being able to produce facial displays on command, but not display spontaneous expressions (see Ekman & Friesen, 1982). Currently, it would be important to uncover which elements differ between the genuine and deceptive expressions produced by successful deceiver.

These findings also speak to the matter of using posed expression from actors in studies investigating facial expression recognition differences in sub-populations; which has tended to be the predominant approach in the emotion recognition literature (Carr & Lutjemeier, 2005; Prochnow, Kossack, et al., 2013). It is clear that there are differences in both perception and presentation between posed and genuine expressions (see Ekman, 2003b; but also, see Krumhuber & Manstead, 2009), relating to intensity and perceived genuineness, however, these do not translate into improved classification accuracy.

The low discriminability found in these studies has interesting implications for cues relating to emotions. The fact that decoders in multiple experiments perceived deceptive expressions as genuine, and were unable to discriminate them from authentic emotions provides new insight into how humans decode emotional information. The logical next step in this research is to analyse the expressions, coding visual differences between their appearance and secondary aspects (e.g. length, fluidity) to understand which factors separate them from genuine expressions (Zloteanu, Richardson, & Krumhuber, in prep). It may be that such differences, as seen with many cues to deception, are faint and unreliable, providing insight into which information is relevant for authenticity discrimination.

The results of this data speak to the emotion recognition literature, especially regarding the methodology such research employs. Specifically, emotion recognition research typically presents dynamic or static stimuli to decoders, and asks them which emotion they see (either based on valence, or category). The responses they receive from participants is rated as their accuracy in correctly identifying the emotions presented. However, considering the results of the current two experiments, there is a vast difference between recognising that a facial display depicts a specific emotion to detecting if the emotions they have decoded are genuine or not. One could argue that the methodology used in the current chapter is closer to 'true' emotion recognition ability, as it not only measures ability to categorise an expression based on emotional content, but also the ability of the decoder to ascertain the authenticity of the expression.

Past research, it could be argued, focused on matching context with an expression. Decoders may attribute an *expected* expression in a particular scenario as decoded correctly (e.g., at a funeral the person is frowning) without perceiving that an emotion is present (i.e. is the person actually sad?). The classification scores measured in most emotion recognition research may simply reflect the process of agreeing that the sender accurately depicted the emotion they were supposed to display. By contrast, the current experiments asked participants the question of whether the expression was a result of the event that should produce the surprised expression, or if it was in its absence. While this adds complexity to a task by not asking a simple classification, it does allow for participants to consider the matter that (a) the expression looks as it should, and (b) it is a response to a genuine emotion evoking scenario, providing valuable insight into emotion recognition ability.

***Implication for Deception Literature.*** More relevant to the current thesis, the results of these two experiment confirm my predictions that liars can, with little effort, produce deceptive expression of an emotion if required to do so. For the deception literature this has important implications, as it speaks directly to the matter of why the emotion-based approach—using emotional cues as markers for deception—does not seem to produce significant improvements in accuracy. Theoretically, it has been argued, and even supported, that liars and truth-tellers experience different emotions, which would suggest that emotional displays, as they tend to occur spontaneously (Hurley & Frank, 2011), and ubiquitously (ten Brinke & Porter, 2012), should betray the lie (i.e. leakage hypothesis). However, research has also demonstrated that such cues (defined more descriptively in this thesis as genuine cues) are rare (e.g., ten Brinke & Porter, 2012), therefore their use as a source of veracity discrimination is poor. What is added by the current results is that beyond the lack of discriminability as a result of leaked cues, decoders may be further misled by the presence of deceptive cues, such as voluntarily produced facial expressions, as they are unable to realise they are meant to deceive.

***Future Research.*** Future deception detection research needs to investigate objective differences between the genuine and deceptive expressions, and extend them beyond the surprise emotion. The next step is understanding what differences, behavioural or temporal, are producing the differences in accuracy between conditions. For example, thus far no research has uncovered 'reliable muscles' relating to the surprise expression, which would allow for training and procedures to be developed to separate expressions based on authenticity, as clearly human decoders do not perform very well at this task.

Furthermore, to generalize these findings to real-world deception, there is need to compare these production techniques with those utilised by successful and unsuccessful deceivers. For example, convicts with psychopathic traits, such as flat affect, are better at deceiving others about being remorseful (Porter, ten Brinke, & Wilson, 2009), implying that knowledge of an emotion is more important than the affect corresponding to said emotion. The present superiority of the external condition over the internal condition supports this view. Similarly, individual differences in expressive control, the ability to display facial expressions deliberately (e.g., Berenbaum & Rotter, 1992; Zuckerman, Lipets, Koivumaki, & Rosenthal, 1975), or emotion regulation (Gross, 1998), may relate to successful production of deceptive emotions, i.e. deceptive emotional control. It could be the case that certain proficient liars have become so due to an increased awareness and control over their own emotional displays (Levine et al., 2011; McKimmie, Masser, & Bongiorno, 2014).

***Limitations.*** While the stimuli produced in the two experiments demonstrates that the surprise expression can be elicited successfully in a laboratory setting, by focusing on the startle component of the experience, it might be argued that expectation had an influence on production. Even the genuine condition maybe have been influenced by expectation of the event: the jack popping out. Similarly, it can be argued that motivation was equal among the deceptive and genuine conditions as all senders were aware they were being recorded and would want to perform well. However, the genuine expressions had overall higher ratings on accuracy, genuineness, intensity, and confidence, suggesting that these expressions contained behavioural markers reflecting real affect.

A potential factor of the current methodology, especially regarding decoding performance, is that these results reflect a best-case scenario for authenticity discrimination. Participants were explicitly asked to judge the authenticity of the expressions they saw, but this conscious, effortful process of detecting veracity may not occur in natural conversation. That is, rarely are people consciously scrutinising the veracity of the emotions displayed by another, reducing the ‘suspiciousness’ that may be required to engage in these discrimination processes. Additionally, the expressions portrayed in the videos (both genuine and deceptive) were rated as high in intensity overall. In everyday scenarios it is unlikely that decoders would see such isolated, intense expressions (e.g., Carroll & Russell, 1997; Reisenzein, 2000; Reisenzein et al., 2006). In the future, it would be useful to compare actors and laypersons performance with genuine reaction, and have a more indirect method of assessing if the observer/partner believes the reaction is genuine. As seen in the current experiments, there were differences in perception which could have assisted decoders, but they seemed incapable of translating these subjective insights into objective accuracy.

Conversely, decoding authenticity may actually improve in real-life by the presence of contextual information. If decoders knew the motives for the sender to be honest or deceptive, they may be better at determining veracity (Blair, Levine, & Shaw, 2010; Bond, Howard, Hutchison, & Masip, 2013). For example, Gunnery and colleagues (2013) proposed that people are able to produce more genuine looking displays in congruent posed conditions than incongruent (such as pretending to be happy when looking at sad images), as the latter creates more cognitive dissonance for the sender. This in itself suggests a potential interplay of deceivers finding it harder to portray incongruent emotions to aid their lies, increasing discriminability, but their deceptive emotions being congruent with the context (e.g., faking being happy at a comedy show) leading to decreased discriminability.

A limitation of this study was the absence of a masked emotion condition; arguably, the most often seen emotional cue in deceptive scenarios (Matsumoto, Yoo, Hirayama, &

Petrova, 2005). This would have required deceptive senders to initially experience an incongruent emotion which they would have to suppress before displaying the deceptive emotion (e.g., a liar suppressing his disgust with a meal served by his mother-in-law). While a different emotion to surprise (which has neutral valence) would have to be used, it would be a worthwhile extension to the current studies as it would reflect the behaviour that may be experienced by liars in high-stakes scenarios. The absence of this condition is justified by the importance of understanding in authenticity discrimination can occur when the expression displayed is absent of underlying affect, not when the expressions displayed is incongruent with actual affect (which would be what past observers might actually be decoding; see Perron, Roy-Charland, Chamberland, Bleach, & Pelot, 2016).

***Conclusion.*** The two experiments presented in this chapter offer evidence for the ability of laypersons to produce facial expressions of emotion on command, which decoders find difficult to categorize as deceptive or genuine. While the different production methods resulted in interesting variations in how the expressions were perceived (e.g., differences in intensity, genuineness), even impacting how confident decoders were in their decision, these differences were not diagnostic of deception. The emotion recognition literature and deception literature both refer to significant differences between posed and genuine expressions of emotions; while currently this fact is not directly contested, these findings are relegated to research measuring these differences empirically. I propose that people are not very adept at discriminating authenticity, which is further impacted by the method such a deceptive emotional expression is generated.

The emotion-based approach to detecting deception utilises training in facial cues and other emotional cues (such as the method utilised in Chapter 5) in the aim of giving decoders the information necessary to separate the liars from the truth-tellers. However, while training can improve the recognition of various emotional cues, if unable to determine their authenticity they serve not diagnostic value. To this effect, currently it can be argued that emotion recognition ability is not the same as emotion authenticity discrimination. This demonstrates the advantage and need of being explicit about the production method used when investigating authenticity discrimination of genuine and deceptive facial expressions, as well as the importance of asking participants both to categorize emotions and to specify their authenticity. This may assist in elucidating past conflicting results regarding deceptive facial expressions and discrimination ability, and lead to an improvement in methodological rigour in facial recognition research.

## Chapter 7: New Avenue in Deception Detection – Situational Factors: The Influence of Handcuffs on Deception Detection and Suspiciousness


**Abstract**

Thus far I have investigated, and challenged, the core assumptions of the emotion-based approach to detecting deception, finding significant differences in how decoders actually perceive emotional information from what is predicted. Of importance in all the previous research is the fact that behavioural information (emotional or otherwise) played a significant role in the detection process. This is important, as it suggest that not only do decoders utilise such information when making veracity judgments, they are also swayed by its presence. The deception literature has mainly attributed variability in response biases to either differences in decoders or in senders. However, a component that is rarely presented is the fact that such differences can arise artificially due to the circumstances in which the deception and decoding process occur. The situation in which senders can find themselves, I propose, can significantly impact their ability to present themselves, and influences the decoders' perception of them due to such non-diagnostic, artificial, situational factors.

In this Chapter, I investigated how interrogation practices affect the believability of suspects and the ability of the decoder (an Interrogator, Laypersons, and Police Officers) to detect deception. Participants were videotaped in an interrogation setting where half were handcuffed. Research suggests that individuals show behavioural differences when lying; the restriction from being handcuffed can make the differences between liars and truth tellers less visible. Additionally, the mere presence of handcuffs may be interpreted as a sign of guilt, biasing perception. The chapter investigates an ecologically representative manipulation of the effects of physical constraints on suspects' ability to appear honest, and the effect this has on the decoders' veracity judgements. It was found that handcuffs have both a physical impact on the ability of suspects to present themselves and on how decoders perceive them and can judge their statements.

## Introduction

As has been fairly evident throughout this thesis, deception detection is a very difficult process and people show very weak performance in discriminating veracity (Bond & DePaulo, 2006). Importantly for the applied sectors, not even experienced decoders or trained professionals, such as police officers, seem to show better performance (Hauch et al., 2014; Vrij, 2008). This is highly problematic, as police officers often need to uncover the veracity of a suspect's statement (Jayne et al., 1994); ensuring that detection accuracy is high and the likelihood of a false accusation is low should be a priority for deception research, especially as it relates to the forensic, security, and legal sectors.

The situation can have a strong impact on behaviour, an aspect people overlook when judging others (Gilbert & Malone, 1995; Nisbett & Ross, 1991; Ross, 1977). In other areas of social psychology there is great importance placed not only on the psychological processes of humans (e.g., cognitive, affective) influencing behaviour but also on the environment in which these processes occur (Brunswik, 1955; Gigerenzer, 2008). The majority of deception research focuses either on diagnostically valid behavioural differences between liars and truth-tellers, or how deception detection ability can be improved. The current chapter addresses a different process of detecting deception. It provides evidence that situational factors can negatively impact the ability of an interrogator and/or a decoder to accurately discriminate deceptive form genuine statements made by senders.

To be specific, situational factors here refer to factors that are not related to either differences in senders or differences in decoders. For example, for differences in senders, the attractiveness of offenders has been found to influence the harshness of sentencing (Sigall & Ostrove, 1975; Zebrowitz & McDonald, 1991), facial tattoos affect judgements of guilt and perceived trustworthiness (Funk & Todorov, 2013), and untrustworthily-looking faces require less evidence to receive a guilty verdict (Korva, Porter, O'Connor, Shaw, & ten Brinke, 2013; Porter, ten Brinke, & Gustaw, 2010). For differences in decoders, profession has been found to influence response bias and perception of guilt (Meissner & Kassin, 2002), while differences in the weight decoders assign to catching liars (i.e. not wanting to wrongfully accuse versus failing to catch a deceiver) also influences response bias (Hurst & Oswald, 2012). Situational factors here are defined as *a manipulation or variable that is a product of the procedure in which the decoding process occurs but is not meant to deliberately influence the performance of either the sender or the decoder.*

In deception the role of situational factors has been addressed to some extent, however, most have defined the situation as factors specific to either the deceiver, the type of lie told, or the type of decoder. Recently, ten Brinke, Khambatta, and Carney (2015) argued that reducing the quality of the environment (i.e. having senders sit in a plain, undecorated, empty room) can lead to improved deception detection, as it results in more nonverbal cues being produced. They attempted to demonstrate this effect through coding the behaviour of real-world liars and truth-tellers in both enriched and scarce environments, as well as by experimentally manipulating the environment in which a sender was interviewed. Their results suggested that being in a scarce rather than enriched environment resulted in higher discriminability between liars and truth-tellers. However, their claims and findings have been contested. Verschuere, Meijer, and Vrij, (2016) showed that not only do such manipulations result in poorer overall accuracy, as the effect of a scarce environment affected both liars and truth-tellers, employing such tactics of depriving suspects of resources, as advised by many police training manuals (Inbau et al., 2011), can result in an increase in false confessions (Meissner & Kassin, 2002), suspiciousness, and lie-bias (Vrij, Mann, & Fisher, 2006b). This illustrates the importance of investigating situational factors on deception and its detection.

Presently, I have focused on an aspect of detecting deception that has not received much attention: the effect of restraining suspects on subsequent judgements of veracity in police interrogations. The goal is to illustrate that deception research must also focus on addressing, and attempting to decrease artificial factors that can result in decreased performance in classifying veracity. The manipulation used was restricting the movement of "suspects" in a police interrogation by having them wear handcuffs. Handcuffs are a usual tool utilised in many police and legal settings. Due to this fact I considered it to be both an ecologically valid manipulation and a useful demonstration of the effect that an ordinary aspect of interrogation procedures can have on detecting deception.

One reason handcuffs may have an effect on deception detection and perception is that they restrict the free expression with hands of senders; that is, handcuffs results in an indirect effect on the sender that is not related to their underlying veracity or individual difference in ability. Gestures are ubiquitous in communication and serve multiple functions in speech (Alibali, Bassok, Solomon, Syc, & Goldin-Meadow, 1999; Alibali, Kita, & Young, 2000; Beattie, 2004, 2016; Ekman & Friesen, 1972; Kendon, 1994, 2004, McNeill, 1985, 1992, 2005; McNeill, Cassell, & McCullough, 1994). Gestures can expand on verbal information (Langton, O'Malley, & Bruce, 1996), add clarity to speech (Goldin-Meadow, 1993; Kendon, 1980), improve the effectiveness of communication (Beattie & Shovelton, 1999; Graham & Argyle, 1975), can aid and provide information that is difficult to articulate (Church & Goldin-Meadow, 1986; Goldin-Meadow, 1999; Thompson & Massaro, 1986), can provide semantic detail that is absent from speech (Kelly, Barr, Church, & Lynch, 1999; Kendon, 1980), or can even contradict the verbalised information (Ekman & Friesen, 1972).

While the role of gestures in deception has not been fully explored, restricting the ability to gesture freely can have varying effects on the discriminability between liars and truth-teller. For example, liars show a reduction in illustrators (i.e. gestures used to complement speech; Ekman, 1988), but an increase in manipulators (i.e. self-comforting gestures; Zuckerman, DePaulo, et al., 1981). Restricting motion might reduce the observable differences between liars and truth-tellers. Conversely, gestures are also used to aid speech production (Feyereisen, 1983; Goldin-Meadow, 2006; Krauss, 1998; Rauscher, Krauss, & Chen, 1996). Liars need to construct responses to unexpected questions from an interrogator on the spot, therefore, restricting their ability to gesture might make speech production and lexical retrieval more difficult, resulting in more verbal differences.

Deception research reports significant differences in the nonverbal behaviour of liars and truth-tellers relating to their body movement. Specifically, liars use less hand, arm, and finger movement compared to truth-tellers (Vrij, 2000, 2008; Vrij, Akehurst, Soukara, & Bull, 2004). However, evidence in terms of the motions displayed by liars is mixed, with some reporting increases (e.g., McClintock & Hunt, 1975; Porter & ten Brinke, 2009), while others decrease (e.g., Porter & ten Brinke, 2010; Vrij, 2000; Vrij, Granhag, & Porter, 2010). A review of multi-cue deception studies found that in 13 out of 35 studies liars displayed a reduction in illustrators, 20 showed no difference, and 2 showed an increase (Vrij, 2008). The meta-analysis by DePaulo et al. (2003) reported that liars use fewer illustrators, and appear more nervous than truth-tellers, but, overall no stable differences were found. However, the more recent meta-analysis of 11 nonverbal cues by Sporer and Schwandt (2007) found that liars engage in less nodding, hand movements, and leg movements.

A potential reason for the evidence being so divided may be due to researchers aggregating multiple movements together, obfuscating any meaningful correlations. For example, the meta-analysis by DePaulo et al. (2003) reported no overall difference in body movement, however, several studies that separated the behaviours based on meaning and type found significant differences between liars and truth-teller (Caso, Maricchiolo, Bonaiuto, Vrij, & Mann, 2006; Hillman, Vrij, & Mann, 2012). Relevant to the current experiment, studies using motion-tracking technology find differences between liars and truth-tellers to be localised to the arms and head areas (Duran, Dale, Kello, Street, & Richardson, 2013). Additionally, liars display less stability and greater complexity in their movement, which has be used to classify veracity with 82% accuracy (Van Der Zee, Poppe, Taylor, & Anderson, 2015).

The difference in body movement has been attributed to lying requiring more cognitive resources compared to being honest, this reduction in resources can manifest as a reduction in the normal behaviour that accompanies speech and interactions (see Cognitive Load Hypothesis in Chapter 2). Alternatively, liars are more likely to attempt to control their speech and behaviour during a deceptive encounter as they want to suppress potential behaviour that can give them away, and to present themselves in a credible manner. However, this behaviour, being voluntarily generated, will result in noticeable changes, such as being improperly synchronised with speech, or rigid, and odd. This account suggests that the difference in behaviour is not a result of reduced resources, but one driven by impression management (see IDT in Chapter 2). Furthermore, liars may attempt to regulate the stereotypical deceptive behaviour (e.g., fidgeting) they believe they are displaying, over-controlling their movements in order to appear honest, and, paradoxically, appearing more restrained and defensive (DePaulo et al., 2003).

What is clear from the research is that behavioural differences in terms of movement can potentially have beneficial effects for detecting deception. Indeed, the work of many researchers at present is to increase these behavioural differences by manipulating the interrogation process itself (see Masip & Herrero, 2015; Sorochinski et al., 2014; Vrij, 2008), however, presently I was concerned with a factor that may *reduce* the discriminability between liars and truth-tellers through the use of physical constraints, such as handcuffs.

It is important to understand that in addition to people being bad at utilising nonverbal information to make accurate veracity judgements, they also hold strong beliefs about their importance and meaning (GDRT, 2006). Stereotypical beliefs also relate to hand movement, such as liars move their body, hands, and/or head more because they feel anxious and nervous (i.e. they fidget). This belief exists both in laypersons and experts (Strömwall, Granhag, & Hartwig, 2004). Even if not diagnostic or even misleading, focusing on hand gestures or other stereotypical cues has been found to influence interviewers' and observers' veracity judgements (e.g., DeGroot & Gooty, 2009; McKimmie et al., 2014).

These inaccurate beliefs are also propagated by training manuals used by many professionals (e.g., police officers; Vrij, Granhag, & Porter, 2010). Indeed, in the forensic and legal literature, demeanour evidence is perceived as an important cue for witness credibility (Mack, 2001; Varinsky, 1992). Furthermore, some police manuals suggest that experience with nonverbal cues can make officers good lie detectors, which has been shown to not be the case (see Kassin et al., 2007). Furthermore, the strongest individual difference impacting veracity decisions is perceived credibility of a suspect (e.g., George, Tilley, & Giordano, 2014). Perceived credibility of a sender has been found to have the largest effect on ratings of honesty. This has been named the demeanour bias (Burgoon, Blair, & Strom, 2008; Levine et al., 2011; Porter & ten Brinke, 2009).

Beyond the restricting effect of handcuffs, their mere presence during an interrogation can influence perception of suspects and the behaviour of the suspects themselves. Suspiciousness is the degree to which a decoder is uncertain of the honesty of a sender's statement, heightening attention to the potential deceptive nature of said statement (Kim & Levine, 2011). Increased suspiciousness can result in a greater likelihood of innocuous behaviour being interpreted as suspicious, leading to a presumption of guilt (Bond et al., 1992; Levine et al., 2000; Levine & McCornack, 1991). The presence of handcuffs may result in decoders inferring that the suspect they are viewing is more suspicious or guilty, as they are a salient cue relating to criminality. This assumption relates to the *illusory causation phenomenon* (McArthur, 1980), which states that decoders can be significantly influenced by the presence of a salient factor in the stimulus (i.e. presence of handcuffs signifying criminality) and attributing this salience to the sender. Alternatively, the presence of handcuffs might cue liars to the potential increased suspiciousness that they will be under if interrogated, resulting in an increased motivation to appear genuine and convincing (Buller, Strzyzewski, & Comstock, 1991; Burgoon & Buller, 1994; Burgoon et al., 1995; Burgoon, Buller, Ebesu, & Rockwell, 1994).

Studies thus far have not found a strong or stable relationship between suspiciousness and deception detection (Buller, Strzyzewski, & Comstock, 1991; Stiff et al., 1992; Toris & DePaulo, 1984), finding that it can decrease truth accuracy (Zuckerman, Spiegel, DePaulo, & Rosenthal, 1982), but increase lie accuracy (Millar & Millar, 1997), resulting in no net gain (see also the "veracity effect"; Levine et al., 1999). Importantly, it has been found that it can influence experts' judgements, while not that of laypersons (Burgoon et al., 1994; Burgoon, Buller, Ebesu, White, & Rockwell, 1996). With respect to the handcuff manipulation, if decoders perceive the gestures and behaviour of the senders as 'different' as a result of the reduced mobility, it may result in them misclassifying the behaviour as either reflecting deceit or honesty. Clearly, it is of great importance to fully understand how beliefs relating to gesturing can affect veracity judgements.

***Interactivity.*** The majority of police officers, judges, and prosecutors hold the belief that deception is easier to spot in face-to-face interaction compared to watching it on video (Strömwall & Granhag, 2003). Furthermore, police veracity judgements are predominantly made on the basis of such face-to-face interactions (Gudjonsson, 1992). While intuitively one might assume that interactive lie detection is easier than watching a recording, the majority of research finds the opposite to be true. That is, interrogators are equally accurate (Granhag & Strömwall, 2001; Hartwig, 2004; Hartwig et al., 2006) or less accurate than passive decoders (Buller, Strzyzewski, & Hunsaker, 1991; Burgoon et al., 1999; Granhag & Strömwall, 2001; Hartwig, Granhag, Strömwall, & Vrij, 2002). Moreover, interrogators tend to be overconfident and truth-bias in their veracity judgements (Granhag & Strömwall, 2001; Strömwall & Granhag, 2003). Face-to-face interactions also influence perceptions, finding increased leniency and positivity towards the suspect (Ambady & Rosenthal, 1992; Burgoon, Buller, Floyd, et al., 1996).

The reason for this is assumed to be that in face-to-face interactions the interrogator themselves experience increased cognitive load and increased behavioural control from maintaining the conversation with the suspect, reducing their ability to actively detect deception (Burgoon, Buller, Floyd, et al., 1996; Feeley & deTurck, 1997; Forrest & Feldman, 2000; Granhag & Strömwall, 2001). This is compounded by the "honesty effect", the assumption that the majority of communication in an interaction is honest, leading to a more favourable perception of the suspect (Burgoon & Newton, 1991; Feeley & deTurck, 1997).

Handcuffs might predispose the interrogator to assume the suspect's statement or behaviour (due either to mere presence or restricted mobility) is indicative of deceit, making the interrogator more suspicious. Suspiciousness can increase a decoder's lie-bias in both interactive (Stiff et al., 1992) and non-interactive designs (McCornack & Levine, 1990a). Being lie-biased in interrogations can have severe negative consequences. Kassin, Goldstein, and Savitsky (2003) found that a lie-bias was related to the use of more coercive interrogation tactics, which they suggest could have a knock-on effect on decoders viewing the videotapes at a later date.

*Probing.* Probing is defined as asking the suspect to answer a previously asked question by requiring they present additional information (Granhag & Strömwall, 2001; Levine, McCornack, & Aleman, 1998). Probing is frequently recommended by many police manuals due to the assumption that it will make a guilty suspect more anxious, increasing the likelihood of nonverbal leakage or a confession (Inbau et al., 2011). However, probing has not been found to enhance deception detection performance (Buller, Strzyzewski, & Comstock, 1991; Stiff & Miller, 1986). While the current experiment used a semi-scripted interview setup, the interrogator was allowed to probe suspects on their statements using either a positive, neutral or negative probe.

Presently, I did not anticipate probing to aid deception detection. However, as the interrogator may be influenced by the presence of the handcuffs, it may have impacted the way he decided to conduct the interrogations. It is believed that if the interrogator is more or less suspicious of the suspect it will influence his use of the different probes. This in turn might affect the suspiciousness of the decoders watching the recordings afterwards (e.g., Levine & McCornack, 2001). Due to these factors, considering the impact of the handcuff manipulation in an interactive setting can increase the ecological validity of the study, while also allowing for a direct examination of the effects of conversational involvement.

***Police vs Observers.*** Research using police officers is quite rare in the deception field, this is due either to the difficulty in collaborating with governmental bodies to conduct research or to the general finding that profession does not influence accuracy. For example, studies investigating differences in passively detecting deception from watching videotapes between police officers and laypersons do not find significant effects on accuracy, even when comparing with student samples (Aamodt & Custer, 2006; Vrij & Graham, 1997; Vrij & Semin, 1996). An explanation for the lack of difference in accuracy between professionals and laypersons is that both rely on the same incorrect behavioural cues to determine deceit (Strömwall & Granhag, 2003; Vrij et al., 2001), especially relating to hand and arm movement (e.g., Akehurst et al., 1996; Bogaard, Meijer, Vrij, & Merckelbach, 2016; Colwell et al., 2006; Vrij & Semin, 1996). Moreover, police manuals emphasise body language as an important source of behavioural cues of deception (Gudjonsson, 2005).

The reasoning for currently testing the handcuff manipulation on both laypersons and police officer was that police officers have more experience with seeing suspects in handcuffs, and because they show difference in veracity judgements to laypersons, as they may hold different baseline perceptions. As handcuffs are used regularly in police interrogations, one could argue that their presence would not have a strong impact on police officers' judgements, as they are habituated to interacting with handcuffed suspects on a daily basis. Therefore, any manipulation that concerns the effect it has on decoders' perception, especially relating to interrogation procedures, needs to account for potential differences that it would have on police officers as opposed to laypersons.

Secondly, in comparison to laypersons, police officers tend to label more statements as deceptive than would be expected by chance (i.e. a lie-bias; Meissner & Kassin, 2002), and tend to be overconfident in their decision (DePaulo & Pfeifer, 1986). This is attributed to a persistent exposure to an environment where deception is likely to occur predisposing decoders to being overly suspicious (Masip, Alonso, Garrido, & Antón, 2005). Moreover, length of job experience has been positively associated with an increase in the lie-bias (Meissner & Kassin, 2002). However, this lie-bias is an inconsistent finding. The meta-analysis by Bond and DePaulo (2006) found that experts were slightly truth-biased, just less so than laypersons, Hurst and Oswald (2012) also found a truth-bias in police officers (although, reduced), while others find a lie-bias in professionals (Garrido, Masip, & Herrero, 2004; Masip, Alonso, Garrido, & Barba, 2008). Currently, I included both laypersons and police officers to account for the potential different effects that handcuffing would have on the perception each group has of suspects, and their subsequent veracity judgements.

***Present Study.*** Under unrestrained circumstances, the research on deceptive cues has illustrated that liars can exhibit reduced body movements due to the increased cognitive demands of lying, or desire to suppress anxious-looking behaviour, or increased gesturing due to wanting to present themselves in a positive image, or to aid their speech production. These factors should result in liars and truth-tellers displaying differences in their behaviour that can be used to ascertain veracity or influence perception of veracity. However, if there is a physical restriction imposed on suspects, both honest and deceptive, these differences will be influenced.

Presently, I attempted to understand if a manipulation that hinders the free hand movement of suspects has an impact on veracity judgements and perception. Furthermore, differences that this manipulation may have on laypersons and police officers was also considered, due to their apparent difference in baseline judgement, and experience with handcuffs. It was predicted that handcuffing suspects would reduce the behavioural differences between liars and truth-tellers, influencing the discriminability between veracities (i.e. lower deception detection accuracy), as restricting motion makes it harder to present yourself (Rauscher et al., 1996). Furthermore, it was predicted that handcuffs would impact the perception of the suspect, influencing the usual response bias of decoders. Finally, this manipulation may influence the interrogator differently from passive observers, whom themselves may differ in accuracy and perception based on being laypersons or police officers.

## Methods

## Stimuli Creation

***Participants.*** *Suspects.* 19 "suspects", (9 male, 10 female), with a Mean age of 21.3 years (SD = 2.96), Age Range = 18-30, were used for creating the video stimuli for the deception detection task. Participants were either approached directly or recruited using UCL's Online Subject Pool. They were provided course credit for their participation. Ethics approval was received for all aspects of the study (CPB/2013/009).

*Interrogator.* One police officer (male, 35 years old) from the Metropolitan Police in London was used as the interrogator. He is a professional interviewer with previous training in interrogations and deception detection.

***Design.*** A 2x2 mixed design was employed. The between-subjects variable being the Handcuffs condition (Handcuffs vs. No-Handcuffs), and the within-subjects variable being Veracity of response (Truth or Lie). The dependent variables were the accuracy score of the interrogator in detecting deception, and his confidence in these judgments, measured on a five-point Likert scale.

***Procedure.*** "Suspects" were alternately allocated to either the Handcuff ($n$ = 10) or No-Handcuff ($n$ = 9) conditions. Prior to the interrogation, participants completed a modified Mach-IV questionnaire (Christie & Geis, 1970); this contained 4 randomly selected items from the complete questionnaire, with responses on a ten-point Likert scale (Strongly Disagree – Strongly Agree). These were: (1) "The best way to handle people is to tell them what they want to hear", (2) "It is safest to assume that all people have a vicious streak and it will come out when they are given the chance", (3) "There is no excuse for lying to someone else", and (4) "All in all, it is better to be humble and honest than to be important and dishonest". After providing their answers the experimenter transferred the participants' responses to a new sheet, and modified two of the responses by moving the Likert scale rating by five points from the original response (e.g., a response of 2 was changed to 7), while the other two remained unchanged. The responses changed and the direction of change (±5) were all counterbalanced between participants. This resulted in each participant having two honest and two deceptive answers. This procedure has been used in deception detection research to manipulate the veracity of statements made by participants (Levine et al., 1999).

Prior to the start of the interrogation, participants were shown the new responses and told they would need to justify them to the professional interrogator during a videotaped interview. The modified response sheet was given to the interrogator, who was blind to the veracity of the responses. Participants in the Handcuffs condition were placed in handcuffs before entering the interrogation room; these were standard UK police-style handcuffs that were placed in the front of the suspect.

During the interrogation, the interrogator read out each of the statements on the questionnaire alongside the participant's responses. He then proceeded with the question "Why did you answer this way?". After suspects provided an initial response, the interrogator prompted them with a probe that was either positive—"That sounds reasonable, but tell me a little more about why you answered it that way"—neutral—" Tell me a little more about why you answered it that way"—or negative—"I don't believe you really think that. Tell me a little more about why you answered it that way". The interrogator judged and marked each statement made by the suspects as either a lie or a truth, and his confidence in these judgement. Afterwards, the handcuffs were removed from the handcuffed participants and all were given six post-interrogation questions, and were fully debriefed.

***Stimuli.*** In total there were 76 recordings made, 40 with handcuffs, and 36 without handcuffs, 38 lies and 38 truths. From here, 16 videos were selected using the same question from all "suspects". The final set was 8 (4 lies, 4 truths) with Suspects in Handcuffs (4 male, 4 female) and with Suspects in No-Handcuffs (5 male, 3 female) (Figure 20).

Figure 20. "Suspects" in the No-Handcuffs (a) and Handcuffs (b) conditions.

**Stimuli Analysis**

The video set was analysed alongside the responses of the “suspects”, to uncover any potential subjective and objective differences caused by the handcuff manipulation.

An initial manipulation check for the videos was conducted. At the start of the experiment “Suspects” were asked about their current mood (Handcuffs, $M = 3.5$, $SD = .53$; No-Handcuffs, $M = 3.3$, $SD = .50$). However, no differences emerged when separating the sample based on Handcuffs condition, $t(17) = -.705$, $p = .49$. Using the post-interrogation questions, an analysis was conducted on self-reported discomfort of “suspects” from the experiment (phrased as “Did you experience any discomfort during the interrogation?” with answers ranging from “No discomfort” to “A lot of discomfort”). The results found no significant differences between the Handcuffs ($M = 3.4$, $SD = .84$) and No-Handcuffs ($M = 3.11$, $SD = 1.17$), $t(17) = -.62$, $p = .541$. The suspects’ self-believed ability to deceive, also measured post-interrogation, was analysed to uncover any differences based on handcuffing. It was found that Handcuffed participants ($M = 2.5$, $SD = 1.18$) felt significantly less convincing than their No-Handcuffs counterparts ($M = 3.56$, $SD = .73$), $t(17) = 2.32$, $p = .03$, 95% CI [.09. 2.02], $d = 1.12$. Finally, perceived task difficulty was analysed based on Handcuffs condition, revealing a marginal effect where handcuffed suspects ($M = 3.9$, $SD = .88$) perceived the task of being convincing in an interrogation more difficult than suspects without handcuffs ($M$ = 3.0, $SD$ = 1.12), $t(17) = -1.97$, $p = .07$, 95% CI [-1.87, .067], $d$ = -0.95. The videos were also subsequently analysed for differences in suspect movement and verbal differences.

***Audio Analysis.*** A rudimentary speech analysis was conducted on the data, analysing differences in speech rate and overall word count produced by liars and truth-tellers in both the Handcuff and No-Handcuff conditions (for details on the data processing, see Fusaroli & Tylén, 2016). An overall difference in speech rate was found as a result of the Handcuffing manipulation, $t(14) = 2.38$, $p = .032$, $d = 1.27$. Suspects with Handcuffs showed a reduced speech rate ($M$ = 2.25, $SD$ = 0.36) than Non-Handcuffed suspects ($M$ = 2.80, $SD$ = 0.32). There was no main effect based on veracity, $t(14) = .05$, $p = .961$. Looking at each veracity separately also produced no significant results, either for Lies, $t(6) = 1.74$, $p = .132$, or Truths, $t(6) = 1.48$, $p = .190$, suggesting the effect was experienced by all handcuffed suspects (Figure 21). Investigating differences in total word count did not reveal any significant differences, however, an overall trend was seen in the data in the same direction as with speech rate (see Figure 22).

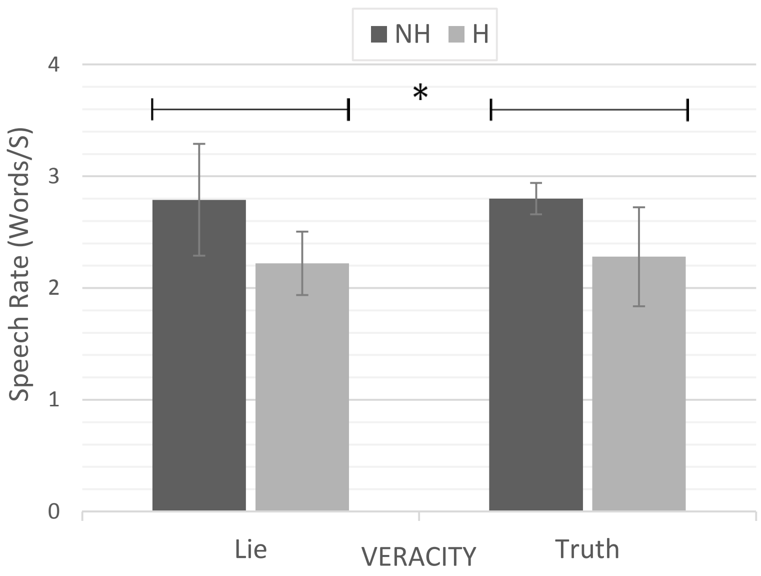


Figure 21. Mean Speech Rate for each experimental condition, Handcuffs (H) and No-Handcuffs (NH), separated by Veracity (error bars indicate ± 1 SD). The line over the bars represents a main effect of Condition (*$p<.05$).

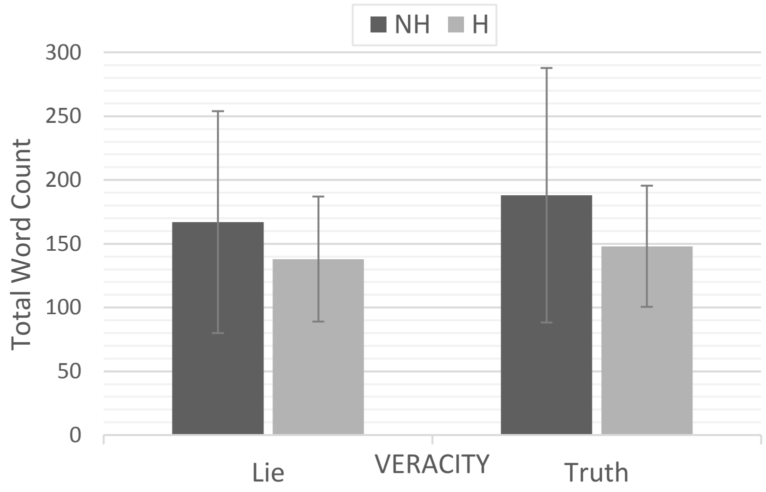


Figure 22. Averaged Total Word Count for each Handcuff condition, separated by Veracity (error bars indicate ± 1 SD).

***Video Analysis.*** An analysis of overall movement of the suspects, based on Veracity and Handcuff condition, was conducted. The movement of the suspects was measured as overall displacement, using the Euclidean distance travelled from point-to-point, resulting in a change in movement variable. The Mean and Variability (SD) were compared. While the data did not find any significant differences based on Handcuffing, all $F < 1$, ns., a trend was observed indicating that handcuffed suspects moved less when being truthful, in line with the prediction of handcuffs restricting natural gesturing (Figure 23).

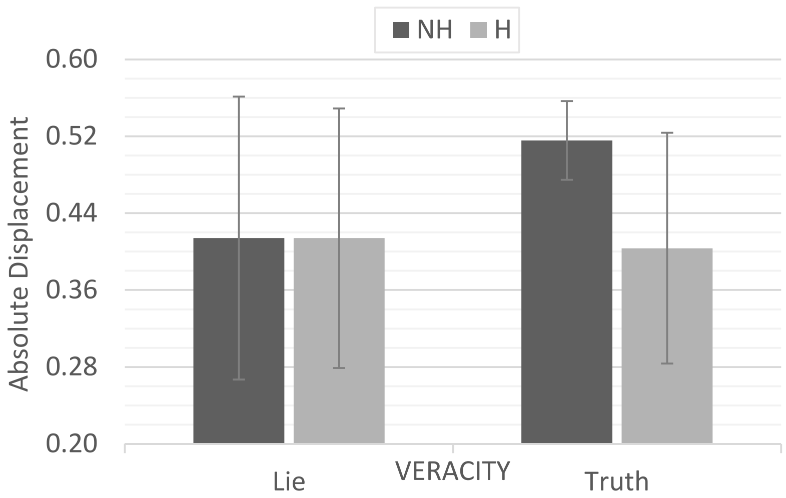


Figure 23. Overall Body Movement of Suspects, based on Handcuff condition and Veracity (error bars indicate ± 1 SD).

**Participants Decoders: Lie Detection**

***Participants.*** *Laypersons.* There was an initial sample of 90 decoders that completed the online deception detection task. After screening the sample for incomplete or incorrect responses (*n* = 5), and for deducing the aim of the study (*n* = 1), the final sample was 84 non-police decoders in the study (37 male, 47 female), $Mean_{Age}$ = 24.1 (*SD* = 6.9). Laypersons were recruited through online advertisement to take part in deception study (either through social media or UCLs Online Subject Pool). Students that took part were offered course credit for their participation, no other incentive was offered.

*Police Officers.* There were 23 Police Officers that took part as decoders in the study (17 male, 6 female), $Mean_{Age}$ = 31 (*SD* = 6.7). Police officers were contacted directly by the experimenter to take part in the study after having obtained approval from the Metropolitan Police Research Department. See Table 1 for details on their levels of experience as officers.

Table 1. Police Officers' level of experience.

| **Experience Level** | ***n*** |
|---|---|
| Special Constable (part-time volunteer) | 11 |
| Probationer (trainee officer) | 3 |
| 2-5 years | 3 |
| 5-10 years | 4 |
| 10+ years | 2 |
| **Total** | **23** |

**Design**

A 2x2x2 mixed design was employed for the Deception Detection part of the experiment. The between-subjects factors were the Handcuffed condition of “suspects” (Handcuffs vs. No-Handcuffs), and Decoder Type (Layperson vs. Police Officer), while the within-subjects factor was the Veracity of statement (Truth or Lie). The dependent variables were the deception detection accuracy score, and confidence in judgement.

## Procedure

The study was conducted online using the Qualtrics® testing platform. Participants were randomly allocated to either viewing the Handcuffs or No-Handcuffs videos. Initial screening of decoders included demographic data, previous experience with deception detection training, and whether they were or not a Police Officer. Police Officers were further asked about their length of service. All participants were instructed to watch each video, decide if the "suspect" is lying or telling the truth, and rate their confidence in this decision. Prior to starting the task, participants viewed a test video to ensure they understood the task (the video was specific to their condition). For each video the decoders had to provide a veracity judgement using a 7-point Likert scale (Very Dishonest – Don't Know – Very Honest), and provide a confidence rating for this judgement using a 7-point Likert scale (Not at all Confident – Very Confident). Finally, all participants were fully debriefed.

## Results

The analysis of the deception detection results are separated based on Decoder Type.

***Interrogator.*** While the current study used a single police interrogator to generate the video stimuli, it is still worthwhile to investigate the impact of handcuffs on an interactive, face-to-face judgment of deception. Separating Lies from Truths, and comparing accuracy scores across all the statements made by participants ($N$=76), between those wearing handcuffs and those without revealed a significant differences in deception detection performance. For Truth accuracy it was found that the Interrogator was significantly worse when suspects wore handcuffs, $p$ = .021, Fisher's exact test, $\varphi$ = -.411. However, no significant differences were found for Lie Accuracy scores between the two Handcuff conditions, $p$ = .468. The responses in each veracity are detailed in Figure 24.

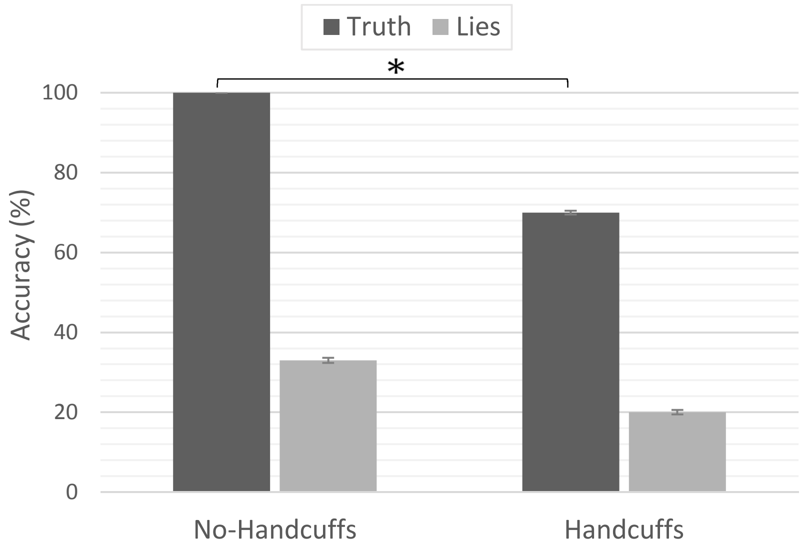


Figure 24. The Accuracy of the Interrogator based on Veracity and Handcuff conditions. Error Bars: ±1 SE; *$p < .05$.

Investigating the response bias of the interrogator, while no significant differences occurred between the two Handcuff conditions, $t(17) = .863$, $p = .121$, an overall truth-bias was observed, $t(8) = 8.00$, $p < .001$ (No-Handcuffs), $t(9) = 3.00$, $p = .015$ (Handcuffs).

The interrogator's use of probes was also analysed as it could reflect an overt suspiciousness towards suspects (i.e. using more negative probes in a specific condition). An analysis was conducted to see if the three probes (positive, neutral, and negative) differed in usage based on the Handcuff manipulation. A Chi-square test revealed that probe usage did not differ between conditions $\chi_2(2, N = 76) = 3.13$, $p = .209$. Similarly, the confidence in of the interrogator was not impacted by the presence of handcuffs, $t(74) = .922$, $p = .359$.

While the interrogator was blind as to which answers were lies or truths, and how many answers were changed, the autocorrelational nature of the data cannot be overcome (i.e. that the responses given to a specific statement will have impacted the response given to another). Nevertheless, the results do illustrate the effect of a simple manipulation of the circumstances in which suspects finds themselves having a strong effect on judgemental performance of the interrogator.

***Deception Detection Task.*** The data from the online decoders was collected and sorted based on Handcuffing condition and Decoder Type. The veracity judgement responses were re-coded to create a dichotomous response format; values of 1-3 on the Likert scale were classified as “Truth” judgements, values of 4 as “Incorrect”, and values of 5-7 as “Lie”. From here, the responses were compared to the actual veracity of the statements to create accuracy scores for truths and lies (the “Incorrect” responses were taken as invalid in the veracity recoding). Two video response questions were excluded from the analysis to ensure an equal number of trial for the analysis, one Truthful Handcuffed video and one Lie No-Handcuff video. Boxplot analyses were conducted to select the videos to be removed.

*Laypersons.* An ANOVA was conducted on the accuracy scores of Laypersons, based on Veracity and Handcuff conditions. A main effect of Veracity was found, $F(1,82) = 4.17$, $p = .044$, $\eta_p^2 = .048$, but no main effect of Handcuffs, $F(1.82) = 1.88$, $p = .174$. The interaction between the two factors was significant, $F(1,82) = 4.82$, $p = .031$, $\eta_p^2 = .056$. Post-hoc analyses revealed that the difference was between the Lie accuracy scores, where lies told by suspects without handcuffs were easier to detect ($M = 50.75\%$, $SD = 3.6$) than lies told by handcuffed suspects ($M = 39.25\%$, $SD = 3.75$), $t(82) = 2.47$, $p = .016$, 95% CI [.93, .10], $d = .55$. The reverse pattern was seen for truths with No-Handcuffs showing a lower detection rate ($M = 57.75\%$, $SD = 3.1$) compared to Handcuffs ($M = 62.35\%$, $SD = 3.6$), but, the difference was not significant, $t(82) = .97$, $p = .334$, 95% CI [-.19, .56].

To further understand the impact that handcuffing suspects had on veracity judgement, an analysis of response bias was conducted. An ANOVA revealed that decoders’ Reponses Bias was affected by Handcuffing, $F(1,83) = 4.13$, $p = .045$, $\eta_p^2 = .048$, showing a higher truth-bias for the Handcuff condition (1.84) than the No-Handcuffs condition (0.56). Comparing responses to no bias (0) revealed that only the Handcuff condition was significantly truth-biased, $t(42) = 2.97$, $p = .005$, 95% CI [.43, 2.26], $d = .92$.

The accuracy data was also analysed using Signal Detection Theory (SDT), as it allow for a detailed understanding of the results by determining if the manipulations had an effect on accuracy and if this improvement can be explained by a biasing of judgement by the manipulation. Two new dependent variables were created using the accuracy scores, A' measuring overall accuracy independently of bias (Rae, 1976), and B" measuring participants' response bias (Donaldson, 1992). For A', a value of .50 indicates chance level performance. For B" <0 values represent a lie-bias, while >0 values indicate a truth-bias. The results revealed that Handcuffs had no significant effect on overall accuracy $F(1,83) = 1.68$, $p = .199$, $\eta_p^2 = .020$, however, a marginally significant effect was found for bias, $F(1,83) = 3.93$, $p = .051$, $\eta_p^2 = .048$, showing a higher truth-bias for the Handcuff condition.

In terms of confidence in veracity judgements no significant difference was seen between the two Handcuff conditions, $F < 1$, ns.

*Police Officers.* The accuracy scores from Police Officers was analysed to understand if their experience with interrogations would produce different effects than those seen in the Laypersons. An ANOVA was conducted based on Veracity and Handcuff condition. While truths ($M$ = 59%, $SD$ = 6.1) and lies ($M$ = 43.3%, $SD$ = 9.0) were easier to detect when viewing suspects without handcuffs compared to with handcuffs (truths $M$ = 43.8%, $SD$ = 7.0, lies $M$ = 35.5%, $SD$ = 5.7), the result revealed no significant interaction effect, $F < 1$, ns., or main effect of Veracity, $F(1,21) = 2.70$, $p = .136$, $\eta_p^2 = .103$, and only a marginal effect of the Handcuff manipulation, $F(1,21) = 3.60$, $p = .072$, $\eta_p^2 = .146$. Analysing the data using SDT did not reveal any different pattern of results, either for discriminability (A') $F(1,20) = 2.01$, $p = .173$, or bias (B") $F < 1$, ns.

Response bias is also an important aspect to consider, given that past research has indicated that professionals can show a different pattern of results to laypersons. The analysis based on Handcuffing revealed no significant differences due to the manipulation, $F < 1$, ns. Additionally, neither of the two Handcuff conditions were significantly different from no bias, $t(9) = 1.26$, $p = .24$, 95% CI [-.77, 2.78] (No-Handcuffs) and $t(10) = .635$, $p = .54$, 95% CI [-1.35, 2.68] (Handcuffs).

Finally, it was prudent to investigate any differences in confidence as a result of both the handcuffing manipulation but also as a reference to overall levels of confidence in police officers. The analysis comparing No-Handcuffs to Handcuffs did not find any significant difference, $t(21) = 2.58$, $p = .017$, 95% CI [-8.03, -.87], $d = 1.13$.

*Police Officers vs Laypersons.* To understand if the difference in accuracy between laypersons and police officers differed significantly subsequent analyses were performed comparing discriminability and response bias. The analysis found a marginally significant effect of accuracy, where laypersons ($M = .54$, $SD = .22$) showed higher accuracy than police officer ($M = .44$, $SD = .23$), even after accounting for bias, $F(1,102) = 3.08$, $p = .082$, $\eta_p^2 = .029$ (see Figure 25).

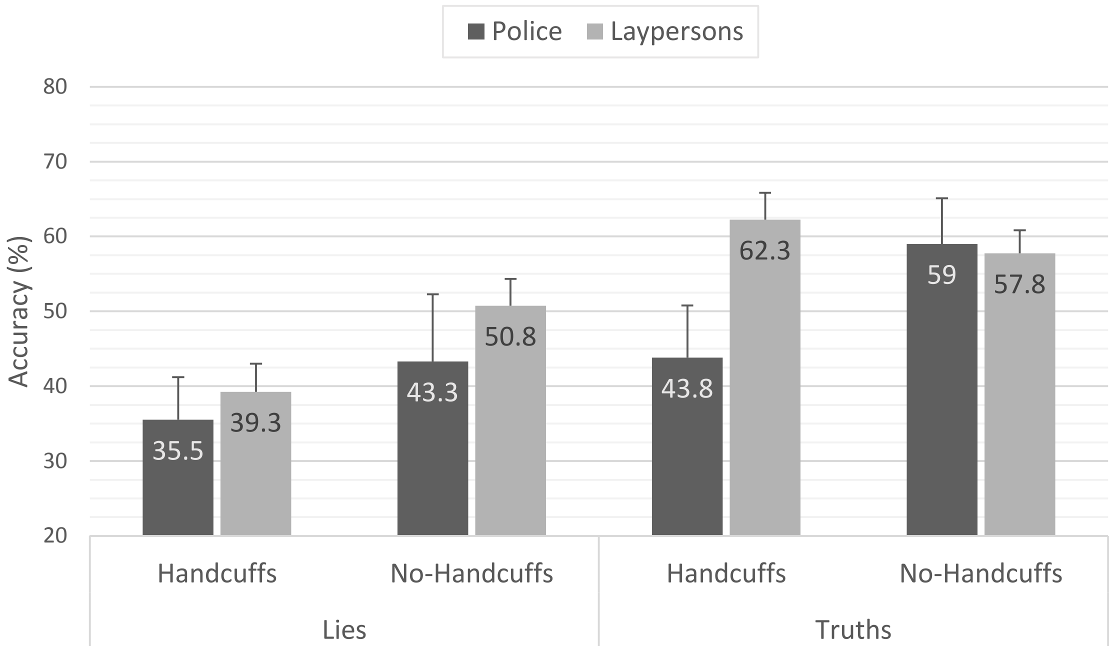


Figure 25. Comparison of Mean Accuracy scores for Police Officers and Laypersons, split over Handcuff conditions, and Veracity (Error bars ±1 SE).

The analysis comparing accuracy between Laypersons and Police Officers did not reveal any significant difference, either overall, $t(103) = -1.40$, $p = .165$ 95% CI [ -.92, .21], or based on veracity (lies, $t(103) = -1.09$, $p = .277$, 95% CI [-.73, .22]; truths, $t(103) = -.55$, $p = .583$, 95% CI [ -.56, .34]). However, the analysis comparing the overall confidence levels of Police Officers (*M* = 41.9, *SD* = 4.7) to that of Laypersons (*M* = 37.9, *SD* = 6.4) did find a significant result, $t(103) = 2{,}69$, $p < .008$, 95% CI [1.33, 6.34], $d = 0.53$. Additionally, no correlations between Accuracy and Confidence were found, either for Decoder (Layperson vs Police Officer) or Handcuff condition.

**Discussion**

Police interrogations procedures should aim to ensure that innocent suspects are not wrongfully accused and guilty suspects are uncovered, as the consequences of making veracity mistakes can be severe. The current experiment demonstrated that while behavioural cues (such as those investigated in the previous chapters) seem to not improve deception detection for decoders, it does influence their perception of liars and truth-tellers (namely, it can bias their responses and reduce accuracy further; but see HSE vs. HSU in Experiment 3). In a proof-of-concept experiment, I provided data to suggest that situational factors (characteristics of a setting in which senders and decoders find themselves) can impact the way liars and truth-tellers differentiate themselves, and the veracity judgements others make regarding them.

This demonstrated that the procedures related to interrogations—the use of handcuffs on suspects—can have negative effects on the deception detection process, both in an active and passive setting. It was predicted that handcuffing suspects would result in a lower discriminability between liars and truth-tellers. Also, that the presence of handcuffs in both the interrogation and the subsequent recordings would impact the perception of suspects. Finally, the role of experience with interrogations was investigated, to understand if this specific manipulation influenced laypersons and police officers differently.

The results demonstrated that using handcuffs in interrogation proceeding reduces differences between liars and truth-tellers, both objectively (minimising behavioural differences) and subjectively (influencing response bias), impacting veracity judgements. Analysis of the stimuli revealed that handcuffing resulted in a reduction in speech production for handcuffed suspects compared to their non-handcuffed counterparts. Similarly, analysing the body movement of the suspects in both conditions revealed a general trend for a reduction for handcuffed suspects when truthful. These two findings suggest that handcuffing has an appreciable effect on the way in which suspects can present themselves during an interrogation, influencing both speech production and (potentially) movement.

***Laypersons.*** For lay decoders it was found that watching videos of handcuffed suspects resulted in decreased lie detection (but not truth detection). Interestingly, looking at the bias results finds that when laypersons were looking at the handcuffed suspects they demonstrated a more pronounced truth-bias than when looking at the non-handcuffed suspects. An explanation for the finding is that the majority of laypersons were students themselves, and seeing other students in handcuffs, taking part in an experiment, might have made them identify with the "suspects", making them more sympathetic and less suspicious (i.e. in-group bias; Brewer, 1999). Alternatively, it could be that the presence of handcuffs did not affect decoders' perception of criminality of the suspects (e.g., Funk & Todorov, 2013). However, the difference in both bias and accuracy suggests the manipulation is driving the effect. Interestingly, laypersons looking at non-handcuffed suspects displayed no response bias in either direction, which is surprising given the literature (Levine et al., 1999).

***Police Officers.*** For Police Officers it was found that handcuffs did not have an effect on accuracy, either for truthful or lie statements; however, a trend showing overall lower detection performance was seen. Encouragingly, this suggests that police officers are not as affected as laypersons by the presence of handcuffs in an interrogation. Additionally, neither of the two conditions influenced response bias for police officers. However, overall police officers showed a decrease in response bias to that of laypersons.

Cultural differences may account for the difference in bias found presently compared to the findings of past research. The UK uses interrogation training focusing more on open communication and information gathering than confessions. This approach may result in police officers being less generally suspicious of suspects, reducing the lie-bias (e.g., Hurst

& Oswald, 2012). Additionally, the majority of the sample contained younger (i.e. less experienced) officer, which have been found to be less suspicious than their senior counterparts, as they have yet to fully embrace the police 'culture' (Masip, Alonso, Herrero, & Garrido, 2016). This is an interesting result for two reasons. Firstly, it demonstrates that experience with interrogations might affect the way external factors influence one's perception of a situation. In this case, finding that watching statements made by handcuffed suspects does not impact decoding performance or bias compared to watching suspects without handcuffs. Secondly, the results suggest that nonverbal behaviour (i.e. gestures) may not be a cue used by police officers when detecting deception, as the lack of an accuracy difference between the two conditions suggests that they rely on different behavioural information to determine suspect veracity than laypersons. The fact that bias was unaffected by the manipulation would seem to support this assumption.

A more worrying result is the overall lower deception detection performance seen in police officers compared to lay observers. These results suggest that police officers are poorer at detecting deception from videotaped interrogations than are laypersons. It could be that police officers took the task more seriously than did other decoders, and this added anxiety resulted in a general decrement in performance, in line with the motivational impairment effect predicted for liars (DePaulo et al., 1988). However, this only provides an interpretation of the results, but one can assume in real-world settings this motivation will be mirrored. Additionally, this explanation is in direct opposition to past arguments that poor accuracy is a result to low motivation to succeed (Vrij, 2008). Two caveats of this effect are the low sample of police officers, reducing the power of the analysis and reliability of the data, as well as the fact that the majority of the sample was composed of more junior officers or volunteers. A replication using a larger and more veteran sample it warranted.

A final interesting result for police officers is that while their accuracy scores did not differ between the two handcuff conditions, the decoders in the handcuffed condition had lower confidence in their judgments, for both lies and truths. This suggests that the handcuff manipulation had an impact on the officers' perception of their own veracity judgements. Usually in deception research confidence and accuracy are not correlated and decoders overestimate their abilities, investigating the effect of the reduced confidence in police officers did not reveal any significant correlations. Therefore, while their confidence in their judgments was reduced, this did not improve their own intuition about their ability to detect deception. Nonetheless, it illustrates that even trained and experienced police officers can be influenced by the situation in which the suspect is placed. At present, the results suggest that experience with interrogations and deception does not aid detection ability, but does reduce the influence of criminality related elements on judgement.

***Interrogator.*** The interrogator was in a face-to-face scenario, where he had to make veracity judgements as the lies or truths were being said, and had the opportunity to probe the suspects based on his own perception of guilt. This added freedom coupled with the psychological effects of maintaining an interrogation could have resulted in marked differences in performance and perception.

Indeed, in line with the study's predictions, the interrogator was significantly influenced by the presence of handcuffs during the interrogations. The results revealed a drop in accuracy for detecting truthful statements made by handcuffed suspects, but not for deceptive statements. This result is in line with the current assumption that truth-tellers gesticulate more during speech production (Goldin-Meadow, 1993; Kendon, 1980), as no differences were found for truth detection, and restricting their ability to do so with handcuffs may have reduced the observable differences to ascertain veracity (Rauscher et al., 1996). This is a plausible explanation as the interrogator did not show any difference in response bias between the two suspect condition, either in use of probes (i.e. overt suspiciousness by using more negative probes for handcuffed suspects) or in response bias (i.e. covert suspiciousness), suggesting only accuracy was affected by the manipulation.

Questioning the interrogator on any specific tactic employed (given his limited flexibility) during the interrogations revealed that he preferred not to use the negative probe, as he believed it might make suspects more tense and defensive, reducing communication and rapport. His insight matches current research on the probing effect, which find that probes actually assists the liar in generating more effective lies, as the suspect realises their interrogator is suspicious and work to control and modify their behaviour to regain trust (Buller, Strzyzewski, & Comstock, 1991; Levine et al., 1998). However, as the result for lie detection was not impacted by the handcuffs manipulation, the results lean towards the former explanation that truth-tellers are affected more by the manipulation, potentially due to them not considering that wearing handcuffs would impact their performance (i.e. illusion of transparency; Gilovich, et al., 1998).

It is true that unlike the other passive decoders, the interrogator, while not explicitly told the hypothesis of the experiment, would have deduced the underlying manipulation, which may have influenced the findings. However, he was blind as to the veracity of the statements, and one would expect such an effect to be reflected in the response bias data; however, this showed no effect on bias due to the manipulation.

While this data is interesting and impactful, it reflects the responses of a single interrogator, and should be taken as such. Nonetheless, it illustrates that there are marked differences of such a manipulation between decoding deception in an active compared to a passive setting.

***Implications.*** A few interesting findings are reported here. Laypersons seem to consider suspects more honest, in addition to the fact that accuracy for detecting lies was lower, may suggest that those particular suspects (i.e. handcuffed and lying) were more aware of the suspiciousness that handcuffs might create making their drive to appear honest stronger. The finding that the investigator was worse at determining that a statement was truthful if the suspect was wearing handcuffs, but showed no difference in response bias, seems to support the assumption that the ability of the honest sender to gesticulate freely was hindered by the handcuffs, making their behaviour not match their statement as well as if unrestrained. Tellingly, this suggest that, while modulated by interactivity, handcuffs have a negative impact on deception detection.

In terms of bias, the data shows that police officers did not show a pronounced lie-bias as assumed by the deception literature (e.g., Meissner & Kassin, 2002), suggesting that the lie-bias may be cultural in nature. The UK's emphasises on an 'ethical approach' to police producers, training on engaging suspects in open dialog, focusing on information gathering (Bull & Milne, 1999; Shepherd & Griffiths, 2013; Williamson, 1993), contrasts the US's emphasis obtaining a confession, the presumption of guilt, and the use coercive techniques (Inbau, Reid, Buckley, & Jayne, 2001). That being said, even officers trained in the PEACE method still have a belief that guilt can be detected from nonverbal behaviour, including gestures (Shawyer & Milne, 2015).

With respect to confidence, in line with past research, it was found that police officers were more confident in their judgements than laypersons. This is a worrying result given the overall lower deception detection performance of officers. This suggests that while they did not show a pronounced lie-bias, or quickness to detect the liar, they were highly confident in all veracity judgements, irrespective of real performance. This overconfidence of police officers is noteworthy as the sample was of fairly junior officers, yet it would seem even limited exposure to police training and procedures can result in an increased self-believed ability to catch liars.

An explanation for the differences between the police officers and the interrogator (who was also a police officer) may be due to the potential differences in the information that each type of decoder paid attention to in order to assess veracity. Passive observers may attend to different information or communication channels than do active decoders (Buller, Strzyzewski, & Hunsaker, 1991; Feeley & deTurck, 1997; Gilbert & Krull, 1988; Gilbert, Pelham, & Krull, 1988; Granhag & Strömwall, 2001; Street, Wiemann, & Mulac, 1988). This would corroborate the interpretation of the current data, as it is assumed the interrogator was more aware and influenced by the behavioural effects of the handcuff manipulation than were police officers watching the suspects on video.

While presently it is difficult to determine if the handcuffing manipulation had an objective effect of the presentation performance of liars and truth-tellers as compared to non-handcuffed suspects, the preliminary audio and video analyses seem to indicate this as a possibility. In line with the current predictions, restricting the ability to gesture freely impacted both overall movement in handcuffed individuals (although only a trend), as well as their speech rate, showing a marked reduction; supporting research on gesturing and speech production (Rauscher et al., 1996).

***Limitations.*** Although the results offer an interesting look at the potential effect such manipulations can have on the interrogation process and subsequent decoding of deception, it is not without a few limitations. The primary limitation is the reduced sample size for the police officers. Due to the time restraints and availability of the officers a larger sample could not be gathered. While the results presented here are in line with predictions and past research, a larger replication would be recommended. Subsequently, using a single interrogator makes any speculation quite tenuous, as research finds large differences between professionals, both in terms of performance and methods they employ to detect deception (Hartwig, 2004; O'Sullivan & Ekman, 2004). This implies that if the study was conducted with a different interrogator the results may differ. It could be argued that the interrogation style used, being semi-scripted, and providing little flexibility for the interrogator may be the reason for accuracy being so poor. However, Vrij, Mann, Kristen, and Fisher (2007) found that interrogation style does not impact deception detection. Therefore, it is doubtful that a different approach would influence the results. Moreover, the study results did not deviate from those observed in past research, especially for the lay observer sample, suggesting that the manipulation served the current purpose well.

While some may argue that while the stimuli attempted to be as ecologically valid as possible, the use of students instead of actual suspects, or individuals with a history of crime may have produced the unimpressive detection rates of police officers in detecting lies (e.g., Frank & Svetieva, 2012; O'Sullivan et al., 2009). However, detectability of deception has not been demonstrated to be affected by the speaker being a student or a non-student, in either low or high-stakes scenarios (Hartwig & Bond, 2014; Zhang, Frumkin, Stedmon, & Lawson, 2013). Furthermore, research has demonstrated that even under optimal, naturalistic, high-stakes settings police officer do not show better accuracy, in either active or passive settings (Hartwig, 2004; Meissner & Kassin, 2002; Vrij & Graham, 1997). This is attributed to the fact that police officers rely on the same (erroneous) information (see Hartwig, 2004). That being said, studies have demonstrated that different types of lies are accompanied by different nonverbal behaviour. For example, Zuckerman and Driver (1985) found that telling planned versus spontaneous lies was associated with fewer arm and head movements. If suspects were asked different questions they might have reacted differently, or the manipulation would have had a different influence on their presentation. This is indeed as aspect that is worth investigating in the future.

***Future Research.*** As this study was largely exploratory, aimed primarily to demonstrate that behavioural cues (e.g., gesturing and speech) can impact veracity judgements and that situational factors can artificially generate these effects, there is ample room to develop this research. Indeed, the primary purpose of this experiment is to bring awareness to the importance of situational factors on the process of interrogating suspects and detecting deception.

Expansions on the current findings should focus on distinguishing between the perception of the suspect influencing accuracy and the role of the actual ability to gesticulate as the source of the effects reported. This can be achieved by forcing both conditions, with and without handcuffs, to be further restrained, such as having suspect place their hands palms down on the table the entire time. This would equate the behavioural differences while having only the presence or absence of handcuffs as the perception component. Alternatively, the suspect's impression management effect can be eliminated through editing the current videos so they are shown with or without handcuffs for the same suspect. Furthermore, to relate to the current theme of the thesis, it would be interesting to uncover if a more emotion specific manipulation, such as restricting the facial mobility of senders (namely, not allowing them to display the appropriate emotional displays while being either genuine or deceptive), can influence the perceived guilt of the suspect.

***Conclusion.*** The current chapter brings an applied aspect to the role of behavioural cues in deception detection (such as those proposed by the emotion-based approach). However, the aim was to demonstrate that while such cues tend to not be diagnostic, at least for decoders, they can still impact veracity judgements. Reducing the impact of such artificial factors could lead to improved interrogation tactics and detection accuracy. It also illustrates the dangers of not considering the effect of such factors on perceptions and judgements. The results revealed that the interrogator's ability to detect truthful statements made by handcuffed suspects was reduced, which was not due to a change in bias. Lay observers seemed to be more truth-biased towards handcuffed suspects, and less able to detect lies. Additionally, police officers did not show a direct effect of the manipulation, suggesting the impact of handcuffs on suspects may have been attenuated by their experience with interrogations, but did display overall lower accuracy, and higher confidence. Overall, the current data demonstrates that more importance needs to be given in research to the role that external, situational factors on perception of suspects, and deception detection performance, as a failure to do so may have severe consequences.

# Chapter 8: Passive Lie Detection – Improving Deception Detection through Embodied Body Postures


## Abstract

In the previous chapter I attempted to highlight that while decoders rarely benefit from attending to behavioural information to detect deception, it nonetheless influences veracity judgements. Past intervention research has focused on active methods of improving accuracy of decoders, such as through training or the identification of adept individuals. This has not produced impressive results. Currently a passive lie detection method is presented aimed at improving the ability of decoders to process behavioural information.

Adopting certain body postures can affect how we process and attend to information in our environment. Presently, the effect of Open and Closed postures on the ability to detect emotional cues and deception was investigated. It was hypothesised that adopting an Open posture would improve nonverbal sensitivity (facial expression recognition) and deception detection. As empathy has been shown to be an important individual difference relating to the accurate recognition of emotional states in other, it was also considered. In Experiment 7 it was found that adopting an Open posture improved veracity discriminability, but not facial expression recognition. The effect was more pronounced in high empaths. In Experiment 8, this effect was partially replicated, and investigated using an eye-tracker to uncover if postures influence the way decoders attend to visual information (behavioural cues) or how they process information. Both low-stakes and high-stakes lies were used, to verify the generalizability of the posture effect. Experiment 8 demonstrated that posture influences gazing behaviour, finding a reduction in attention given to senders, reflecting either more efficient processing of behavioural cues or a lower reliance on such information. The results of the two experiments are discussed in terms of theories of social acuity and information processing, and demonstrate a new avenue of research for improving deception detection.

## Introduction

Deception detection focuses on two related issues: identifying observable differences between liars and truth-tellers, and on the ability to accurately distinguish between them. All deception detection techniques aim at reducing the uncertainty surrounding the veracity of people's statements and improving accuracy.

In this chapter I explore a new method of detecting deception through the use of body postures. This is an attempt at improving deception detection performance by passively affecting the ability of the decoder to perceive and interpret the behavioural information of the sender (i.e. social acuity). In the deception literature, passive lie detection usually refers to observing behavioural differences in senders without interference, such as by watching video tapes of interrogations. I define passive lie detection as any method used by the decoder to improve their deception detection performance—increasing accuracy without influencing bias—that does not require manipulating or influencing the information gathering process or the sender's circumstances.

***Deception.*** As I have described and demonstrated in the previous chapters, the ability to detect deception is generally only slightly above chance level (Aamodt & Custer, 2006; DePaulo et al., 2003). Moreover, individuals are truth-biased when it comes to detection (Levine et al., 1999), and tend to be overconfident in their ability to detect deception (Holm & Kawagoe, 2010).

Past attempts to improve accuracy tend to be based on instructing participants to either expect lies (increasing vigilance and suspiciousness) or provide deception cue training. However, as seen from Experiment 3, these methods rarely show significant improvements in accuracy (Hauch et al., 2014), and have the downside of biasing judgement (Kim & Levine, 2011; Levine, Serota, et al., 2010). The current chapter puts forward a novel method of improving the accuracy of detection of deception by passively facilitating the recognition and/or processing of behavioural cues, without the use of training or sender manipulation.

***Facial Expressions.*** Nonverbal communication has an important relationship with deception and deception detection, especially regarding emotions. Facial expressions of emotion have evolved to express and regulate the experience of specific emotional state (Shariff & Tracy, 2011); these occur automatically and may be expressed unconsciously by the deceiver. As reviewed in Chapter 2 and 3, liars are more likely to experience guilt, fear, and/or delight from lying (Ekman, 2003a). Furthermore, liars' behaviour also involves simulated emotions reflecting their false statements or the concealment of genuine emotions (e.g., ten Brinke et al., 2012).

A large portion of the literature connecting facial expressions to cues of deception relates to microexpressions (Ekman & O'Sullivan, 2006). Recent studies have criticised the existence of microexpressions, finding that they occur very rarely, or are only partial expressions (Barrett, 2011;  Shaw et al., 2013), however, their presence in deceptive scenarios, especially high-stakes, has been supported (ten Brinke & Porter, 2012)

My own research has demonstrated that lay observers and trained individuals fail at utilising emotional cues to detect deception, which was demonstrated in Chapter 6 to be a reflection of the lack of authenticity discrimination ability of the decoders. However, from the Experiment 4-5 it was shown that decoders may have implicit knowledge of such cues (as seen from the differences in perception of deceptive expressions), but cannot connect these to their veracity judgements. Currently, the proposed method of detecting deception is aimed at improving the ability of decoders to accurately detect these emotional cues, leading to improved accuracy. Furthermore, laypersons believe that facial expression are the source that can best betray deception, and are more likely to focus on these when determining the veracity of a statement (GDRT, 2006). Additionally, compared to other social stimuli, facial expressions receive preferential processing in the brain (Alpers & Gerdes, 2007; Vuilleumier, Armony, Driver, & Dolan, 2001), relying on a single system for all emotions (Eimer & Holmes, 2007). As facial expressions seem to be a less controllable channel of communication, it is sensible to consider the impact of a manipulation aimed at increasing the recognition of behavioural cues on its effect in recognising facial expressions of emotion.

***Body Postures.*** Previous research has indicated that body postures signal internal emotional changes (Neumann, Förster, & Strack, 2003), and that adopting such postures can influence affect, behaviour, and cognition (Beigel, 1952). Studies looking at bodily states have found that manipulations as simple as inhibiting someone's smile while viewing funny cartoons can influence their experienced amusement (Strack, Martin, & Stepper, 1988). Cacioppo, Marshall-Goodell, Tassinary, and Petty, (1992) had participants either pull or push a leaver (approach and withdrawal behaviour) in response to stimuli, which influenced the amount that they liked the stimuli, irrespective of valence. Similarly, shaking or nodding one's head (signalling agreement or disagreement) when presented with persuasive arguments has an effect on attitudes towards the message (Wells & Petty, 1980). Riskind and Gotay (1982) found that placing participants in a slumped, compared to an upright posture, led to increased feeling of helplessness and decreased time and effort devoted to a puzzle task, while Stepper and Strack (1993) found that placing participants in a slumped posture resulted in diminished feelings of pride. Price and Harmon-Jones (2010) showed that either leaning towards or away from something influences approach motivation behaviour, increasing or decreasing it respectively. Similarly, Carney, Cuddy and Yap (2010) placed participants in either a powerful posture (expansive) or a powerless posture (contractive) increasing feeling of power, and even hormone production (testosterone) in the powerful posture. Overall, this evidence suggests that simple posture manipulations can have a significant effect on how one perceives and interacts with their environment.

Postures can be considered as a cue to how one must react and interpret information. The assumptions made by the current study relates to the concept of embodied cognition (Alač & Hutchins, 2004; Clark, 1999; Wilson, 2002), which states that cognitive and emotional processes are grounded in bodily states relating to sensory processing of information (Borghi & Pecher, 2011; Cesario & McDonald, 2013), similar to the embodied simulation account for facial expressions. Body postures may facilitate low effort processes such as mere associations by serving as simple cues relating to the meaning of stimuli, and self-perception (Bem, 1972; Priester, Cacioppo, & Petty, 1996). These may indicate to individuals what it is they should be feeling and attending to (e.g., I am smiling therefore I am happy). Postures may influence the direction, amount, or likelihood that certain thoughts occur (Neumann et al., 2003). For example, Bull (1987) reported that slouched, compared to upright, posture affected the interest and attention paid to the task given to participants. While D'Mello, Chipman, and Graesser (2007) found that leaning was associated with both perceived and self-rated measures of task engagement.

The prediction made regards the effect body postures have on social information processing. Certain body postures are representative of specific mental and affective states (Mesquita, 2003), such as sadness or boredom, but unlike facial expressions which are categorical in nature, body postures are more representative of gross affect (Ekman & Friesen, 1967) reflecting dimensions such as friendliness-unfriendliness (Mehrabian & Friar, 1969), or, more relevant to the current research, openness-closedness to communication. The present study is interested in the effect of adopting either an open or a closed body posture on social acuity. Open postures can produce power-related feelings (Tiedens & Fragale, 2003), cognitions (Riskind & Gotay, 1982), even hormonal changes related to dominance (Carney et al., 2010). Conversely, closed postures relate to sensitivity to how others evaluate you (Keltner, Gruenfeld, & Anderson, 2003), activation of the inhibition system (Anderson & Galinsky, 2006), reduced expressivity regarding one's self and decreased gesturing (Anderson & Berdahl, 2002). Additionally, an Open posture can improve memory retrieval, while Closed postures result in reduced contact with the environment (Bernstein, 1973). Presently, it is proposed that these postures will facilitate or hinder information processing in social stimuli, such as the accurate recognition of behavioural cues.

***Empathy.*** Empathy can be viewed as a tool for acquiring emotional information about an individual by facilitating the reception of social information (Karniol & Shomroni, 1999). Research has linked individual differences in empathy with abilities such as theory of mind (Neufeld & Chakrabarti, 2016) and quicker facial expressions recognition (e.g., Carr & Lutjemeier, 2005; Gery et al., 2009), but, as seen from the research in this thesis, not necessarily better deception detection (see also Dimberg, Andréasson, & Thunberg, 2011).

The evidence suggests that empathy may affect sensitivity to emotional content and, potentially, the accuracy of behavioural cue recognition (e.g., Martin, Berry, Dobranski, Horne, & Dodgson, 1996). However, higher trait empathy has not been found to result in improved detection of faked emotional displays (Hill & Craig, 2004) and can even hinder deception detection (Experiment 2, in Chapter 5). Due to this unreliable but recurrent relationship between deception cues and facial expressions it was considered important to account for individual differences that may relate to one's ability to recognise emotional states and facial expressions of others.

**Experiment 7: Body Postures, Cue Perception, and Deception Detection**

The first experiment investigated if an Open posture would facilitate the accurate perception and interpretation of behavioural cues, such as facial expressions, as compared to a Closed posture which may hinder recognition of such cues. Adopting an Open posture is presumed to facilitate openness to communication while adopting a Closed posture should relate to being closed off to communication and interaction.

It was predicted that decoders adopting an Open posture would show higher facial expression recognition rates than decoders adopting a Closed posture. Additionally, as this effect is considered to aid the understanding of others internal states, individual differences in empathy were considered. It was predicted that higher empathy would reflect a stronger effect of the posture manipulation. Finally, it was predicted that adopting an Open posture would result in improved deception detection performance, compared to adopting a Closed posture, as decoders would fare better at perceiving and interpreting the available behavioural information produced by liars and truth-tellers, improving discriminability.

## Method

***Design.*** A three-way independent design was used, with three independent variables, participants' Posture (Open or Closed), message Veracity (Lies and Truths), and trait Empathy (High or Low). The dependent variables were: truth and lie accuracy, discriminability (A'), response bias (B''), and Facial Expressions Recognition performance.

***Participants.*** 80 participants took part in this experiment (30 male, 50 female), with $Mean_{Age} = 25.30$ (*SD* = 8.49). The participants were randomly divided, with 40 participants in the Open posture (14 male, 26 female) and 40 in the Closed posture condition (16 male, 24 female). Participants were selected opportunistically using UCL's Online Subject Pool, and received either financial compensation (£1) or course credit.

***Measures.*** *Facial recognition task.* For the Facial Expression Recognition test the Pre-Test section of the METT software was used, measuring participants' ability to detect the seven basic emotions.

*Empathy.* To measure individual differences in empathy the IRI was used. Due to the high correlation between the four subscales the overall score for each participant was used (see Karniol & Shomroni, 1999).

***Stimuli.*** 12 videos from the BDS (Street et al., 2011), were selected for the Deception Detection Video Task. The videos were controlled for gender, veracity (6 lies and 6 truths), and order of story (lie told first or second); the same speaker was never used twice.

***Procedure.*** Before the tasks began, participants were randomly placed in either the Open or Closed posture. They were given verbal instructions on how to adopt the posture and shown a visual depiction of the postures (see Figure 26), and the words "open" and "closed" were never used, to prevent confounds. The Open posture had participants seated with their arms uncrossed and legs uncrossed, while the Closed posture had participants sit with their arms folded at chest height and legs crossed.

All responses to the tasks were done verbally by participants, to maintain their posture throughout the experiment. The first task performed by participants was the METT task, to assess facial expression recognition. The task involves having participants view a neutral expression, followed by an expression of an emotion for 1/25 of a second to which they respond with the name of an emotion from a list of seven (displayed on screen). Before the task began they were given a demonstration of the software. The second task was the Deception Detection Task, where participants viewed the 12 short videos of people either telling a lie or the truth. Before the task began participants read the instructions relating to the task and were presented with an example video. After each video, participants stated their veracity judgements, replying using a 7-point scale ranging from “Very Dishonest” to “Very Honest”. Afterwards, the IRI questionnaire was administered, and participants were fully debriefed. The experimental procedure took approximately 20 minutes to complete.

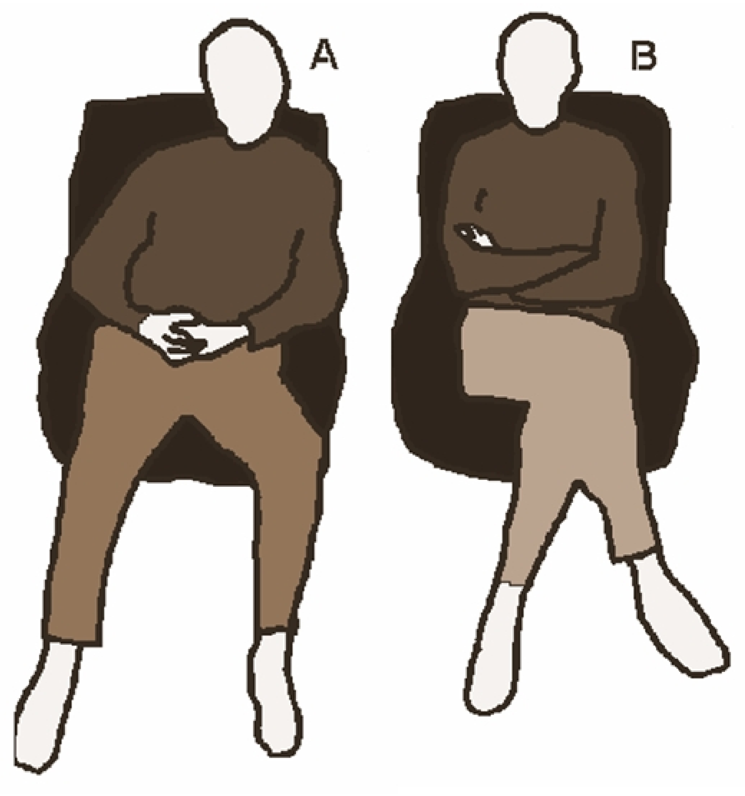


Figure 26. Visual depictions of Postures, Open (A) and Closed (B).

**Results**

The empathy score from the IRI was turned into a classification variable using a median split, with two levels: High and Low (Median = 70.00, range 31-94).

While gender was not predicted to have any interaction effect with the other variables, it was analysed to exclude the possibility of such an effect. A 2x2x2 independent ANOVA was conducted using Gender, Posture, and Empathy, revealing no significant effects. Therefore, all subsequent analysis do not use Gender as a variable.

***Facial Expression Recognition.*** Participants' METT score represented the percentage of facial expressions that were correctly identified. An ANOVA was conducted to investigate the effect of Posture and Empathy on facial expression recognition. The results showed no statistically significant effect of Posture, $F < 1$, ns., Empathy, $F < 1$, ns., or Posture X Empathy interaction, $F(1,76) = 2.70$, $p = .105$, $\eta_p^2 = .034$.

The results of the METT were also analysed exploring if Posture has a temporal component (i.e. takes effect the longer the posture was kept), as the facial expression task was performed first. The score of each participant was divided into the first and last 7 expressions, taken as Time 1 and Time 2. The results did find that participants were more accurate at recognising facial expressions in Time 2 ($M = 5.10$, $SD = 1.37$) compared to Time 1 ($M = 4.50$, $SD = 1.34$), $F(1,78) = 10.75$, $p = .002$, $\eta_p^2 = .121$, indicating a practice effect, but no effect of Posture, $F < 1$, ns., or a Posture X Time interaction, $F < 1$, ns., suggesting that time sat in the posture was not a factor influencing the effect on recognition.

***Deception Detection Performance.*** The responses on the 7-point Honesty scale (-3 to +3) were collapsed to form three possible responses. Responses from -3 to -1 (Very Dishonest to Somewhat Dishonest) it were recoded as 'Lie', responses from 1 to 3 (Somewhat Honest to Very Honest) were recorded as 'Truth', and responses of 0 (Uncertain) was marked as an incorrect answer as it did not reflect a judgement in favour of any veracity. This was done as differences in certainty relating to the speakers honesty are not believed to reflect differences in accuracy (i.e. “Very Honest” is not more accurate that responding with “Honest”). The responses where then compared to the actual veracity of each video and given a score of either “correct” or “incorrect”. An analysis of the number of ‘Uncertain’ responses was performed, on Posture and Empathy, to ensure that the manipulations did not influence uncertainty. The results of the ANOVA found no significant effect of Posture on selecting Uncertain, $F < 1$, ns., nor effect of Empathy (High vs. Low), $F(1,76) = 1.97$, $p = .164$, $\eta_p^2 = .025$, or an interaction, $F < 1$, ns.

An ANOVA was carried out using Veracity, Posture, and Empathy as factors investigating differences in Accuracy. The results revealed a main effect of Veracity, $F(1,76) = 112.96$, $p < .001$, $\eta_p^2 = .598$ (Truths being easier to detect, $M = 71.84\%$ , $SD = 19.67$, than Lies, $M = 31.34\%$, $SD = 24$), but no main effect of Posture, $F(1,76) = 2.00$, $p = .161$. The interaction between Veracity and Empathy was not significant, $F(1,76) = 1.50$, $p = .225$, nor was the three-way interaction considering Posture, $F < 1$, ns. However, the Veracity X Posture interaction was significant, $F(1,76) = 4.23$, $p = .043$, $\eta_p^2 = .053$.

As compounding the accuracy scores may obscure significant effects (Levine, et al., 1999), this was divided into two levels, Truth and Lies. To deconstruct the interaction, a 2x2 ANOVA on Posture and Empathy using accuracy scores of the Truth videos was conducted. As predicted, Posture had a statistically significant effect on accuracy, $F(1,76) = 8.30$, $p = .005$, $\eta_p^2 = .098$. Participants in the Open posture condition had significantly higher accuracy ($M = 4.65$, $SD = 1.17$) than in the Closed posture ($M = 3.98$, $SD = 1.10$). The effect of empathy on truth detection demonstrated a marginally significant effect, $F(1,76) = 2.90$, $p = .092$, $\eta_p^2 = .037$, in the predicted direction of the High empathy group ($M = 4.49$, $SD = 1.05$) outperforming the Low empathy group ($M = 4.15$, $SD = 1.28$) (see Figure 27).

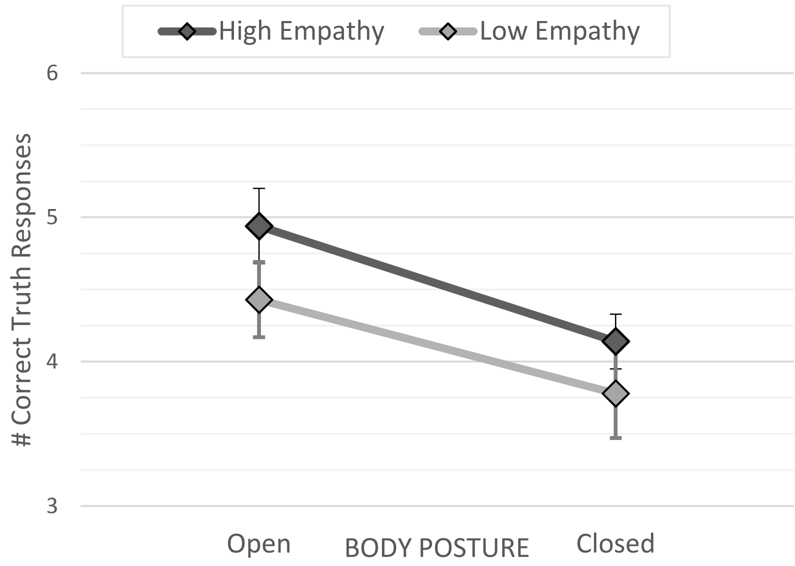


Figure 27. Main effect of Posture (Open vs. Closed) and of Empathy (High vs. Low) on the accurate detection of Truth videos (Error bars ±1 SE).

The 2x2 ANOVA investigating the effects of posture and empathy on Lie detection accuracy did not find any significant effects, all $F < 1$, ns.

***Signal Detection Theory Analysis.*** To ensure that the results stated above for the increased accuracy of deception detection was not due to any biasing induced by the Posture or Empathy conditions, the data was analysed using Signal Detection Theory (SDT), as it provides an additional method of uncovering any discriminability differences (A') while accounting for response bias (B").

A 2(Open vs. Closed) X 2(High vs. Low empathy) independent ANOVA was conducted using A', to analyse if the posture manipulations had a real effect on deception detection performance. A' has a range of 0 to 1, with 0.5 indicating chance performance. The results revealed that Posture had a statistically significant effect on accuracy, $F(1,76) = 4.52$, $p = .037$, $\eta_p^2 = .056$ , where participants in the Open condition ($M = .66$, $SD = .19$) outperformed individuals in the Closed condition ($M = .57$, SD = .21). However, Empathy by itself was not found to have a significant effect on accuracy, $F(1,76) = 2.27$, p = .136, $\eta_p^2 = .029$, nor an interaction term, $F < 1$, ns., (see Figure 28).

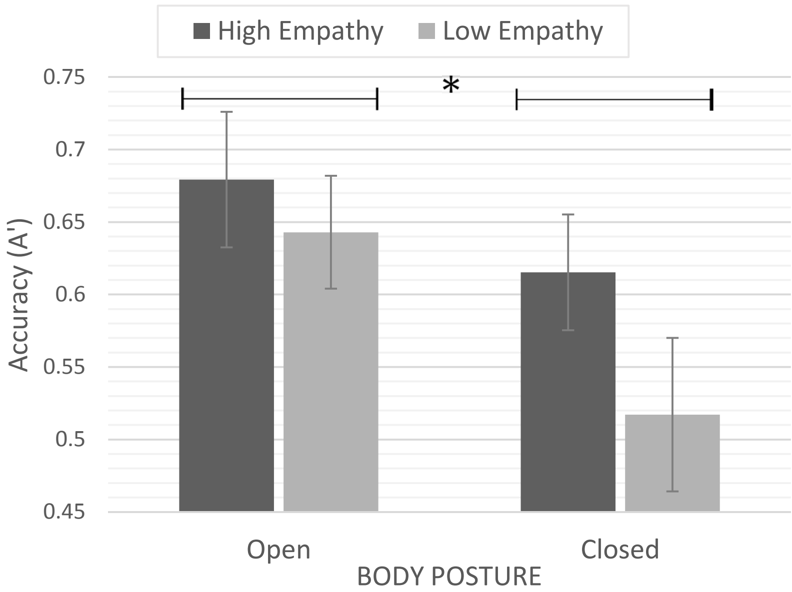


Figure 28. SDT A' scores for participants based on Posture and Empathy (error bars ±1 SE); the bars represents a main effect of Posture, *$p < .05$.

A second 2X2 ANOVA was conducted using B", to uncover the effect of Posture and Empathy on response bias. This measure explains if the increased accuracy is due to a biasing effect in participant's responding or a genuine increase in deception detection. The results of the analysis did not reveal a statistically significant results of either Posture, $F < 1$, ns., or Empathy, $F(1,76) = 1.04$, $p = .311$, $\eta_p^2 = .013$, suggesting that the accuracy effect cannot be accounted for by a response bias. Overall, decoders in both the Open ($M = .62$, $SD = .55$) and Closed ($M = .54$, $SD = .48$) postures were significantly truth-biased, $t(39) = 7.15$, $p < .001$, 95% CI [.44, .79], $d = 2.29$, and $t(39) = 7.05$, $p < .001$, 95% CI [.39, .69], $d = 2.26$.

**Discussion**

Currently, the effect of adopting either an Open or Closed posture on the recognition of facial expressions of emotions and on the accuracy of deception detection was investigated. The study also considered the importance of individual levels of empathy on the aforementioned effects. It was hypothesised that decoders adopting an Open posture would outperform those adopting a Closed posture on recognising facial expressions and detecting deception. Additionally, it was predicted that individuals with High empathy would benefit more from the posture manipulation compared to individuals with Low empathy. The results demonstrated showed (almost) full support for deception detection predictions, finding that adopting an Open posture improved accuracy, while that High empathy resulted in a (marginally) improved effect on detecting deception.

The analysis conducted on the facial expression recognition scores did not reveal the predicted facilitating effect of the Open posture, suggesting that posture is not related to the accurate recognition of emotional cues. The time effects analysis also did not indicate a significant interaction, suggesting that the amount a posture is held does not influence its effects. This is congruent with past research suggesting that posture effects can occur as quickly as 10 seconds after adopting them (Rossberg-Gempton, Dickinson, Kristiansen, & Allin, 1992 in Rossberg-Gempton & Poole, 1993). While the predicted effect of postures was that it would improve the recognition of behavioural cues, the results find that posture had no effect on overt facial expression recognition. These findings resonates with those in Chapter 5 (the lack of relationship between METT, SETT and Accuracy in Experiments 2-3), supporting one of the assertions of this thesis that overt classification of facial displays is a separate process from covert emotion recognition and/or deception detection.

The second hypothesis predicting that participants in the Open posture condition would have higher deception detection accuracy was supported. The results of the analysis found that sitting in an Open posture resulted in higher discriminability for detecting deception, compared to sitting in a Closed posture. Furthermore, and more important for an intervention study, the increase in accuracy was a statistically significant effect not attributable to an increase in response bias.

The results from the raw accuracy found that the effect of posture was significant for detecting truthful but not deceptive statements, suggesting the process of truth detection and lie detection are separate (Levine et al., 1999). The absent lie detection effect is not surprising given that in low-stakes scenarios, such as the ones used in this experiment, there are fewer and less intense nonverbal cues present (O'Sullivan et al., 2009). Even if postures facilitated the perception of behavioural cues, if they were too subtle or absent, then detection rates would not be affected. However, my proposition that in low-stakes there should be more deceptive cues displayed by liars should either have resulted in improved classification (if discriminability is influenced) or decreased accuracy (if only perception of cues is improved). The latter proposition relates to the open posture improving the perception of nonverbal cues, but lay beliefs being inaccurate (Bogaard et al., 2016) and decoders being easily fooled by deceptive emotions (Experiment 4-5) resulting in worse accuracy. That is, if participants did not judge the perceived cues correctly then accuracy would be impaired. However, the lack of an increase in response bias suggests that misclassification is not the favoured explanation.

Overall, Experiment 7 provides initial support for the primary manipulation of body postures influencing the detectability of deception. However, the mechanism behind the above effect cannot be disentangled without a better understand of the factor influencing accuracy. The improved deception detection may be a result of the posture manipulation improving attention to behavioural information (verbal or nonverbal) or influencing the information processing style used by decoders (e.g., increasing resources allocation to processing information, and being more analytical).

**Experiment 8: Body Postures, Stakes, and Visual Attention**

The initial hypothesis that different postures affect the decoder's sensitivity to behavioural information was only partially supported, as accurately determining veracity was indeed affected, but the ability to classify brief facial expressions of emotions was not. To unpack the effect of posture, Experiment 8 expanded the current methodology by including high-stakes videos, which are considered to contain more behavioural cues, as well as employ an eye-tracker to observe if participants in different postures attend to different aspects of the stimuli.

As Experiment 7 found no effect of postures on facial expression recognition but a tentative interaction with individual differences in empathy, it was considered relevant to incorporate other measurements of interpersonal sensitivity that separate the emotional and cognitive components of interpreting the affective state of others. To this effect the 'Reading the Mind in the Eyes' (RMIE) task (Baron-Cohen et al., 2001) and MiniPONS test (Bänziger, Scherer, Hall, & Rosenthal, 2011) were added. The RMIE task was originally developed to ascertain differences in theory of mind, and has been used as a measure of nonverbal sensitivity in clinical and non-clinical samples, assessing differences in social cognition. The MiniPONS is a test measuring the ability of individuals to decode the affective state, interpersonal attitudes, and communicative intentions of another person from various nonverbal channels. Both measures are used regularly to ascertain differences in interpersonal sensitivity, as well as a measure of decoding accuracy for nonverbal behaviour (Hall et al., 2009). Understanding which underlying factor or individual difference is interacting with the posture manipulation may allow for a better understanding of both the mechanism behind the effect and its generalizability.

A final modification to the previous experiment is the inclusion of high-stakes video lies in the decoding task. As mentioned in Chapter 2 and 5, stakes are assumed to increase the discriminability between veracities by exacerbating the nonverbal and verbal cues of liars. While some have argued that stakes do not aid discriminability for decoders (Hartwig & Bond, 2014), it is worthwhile to see if the posture manipulation has the same beneficial impact in a more ecologically valid context (i.e. mock crime interviews).

Therefore, the current experiment aimed to extend the findings of the Experiment 7, and clarify the source of the effect, if possible. It was predicted that measures of nonverbal sensitivity may interact with the posture manipulation as the trend with empathy. Secondly, the posture manipulation will benefit the veracity classification of high-stakes videos more so than the low-stakes videos. Finally, it is predicted that the posture manipulation will affect the eye movement and/or fixation time of decoders.

**Methods**

***Participants.*** 32 students (6 male, 26 female), $\text{Mean}_{\text{Age}} = 19.88$, ($SD = 1.98$), were opportunistically recruited using UCL's Online Subject Pool. All participants had no reported visual impairments. They received course credit for their participation.

***Design.*** A 2x2x2 mixed-design was employed, with Posture (Open vs. Closed) and Empathy (High vs. Low) being the between-subjects variable, and Stakes (High and Low) being the within-subjects variable. The main dependant variables were the accuracy scores (Truth, Lie, and Overall Discriminability), and confidence. Measures of theory of mind, nonverbal sensitivity, and empathy were also collected.

***Stimuli.*** There were a total of 36 videos used, 18 for the low-stakes condition, and 18 in the high-stakes condition.

*Low-stake videos.* The 18 low-stakes videos (7 male, 11 female) were selected from the BDS. As the individuals in the videos were in a situation where there were no rewards for being successful or consequences for being caught it can be assumed the lies and truths told were low-stakes.

*High-stake videos.* The 18 high-stakes videos (10 male, 8 female) were selected from the set used in Levine's (2007) trivia game interviews. In Levine's study, students played what they believed was a teamwork game where they could win a cash prize. They worked with a partner, whom, unbeknownst to them, was one of the researchers. During the trivia game, the experimenter steps out, leaving the trivia answers unattended. The confederate attempted to convince the participant to cheat. The videos are of the post-trivia game interviews where the participants were asked if they had cheated. 9 videos were of participants that had cheated, and 9 of participants that had not cheated. All videos were on average 20s long. The videos are considered high-stakes as participants believed they were subject to the university rules, which if violated could have severe consequences, including expulsion, and if they were successful could win a monetary reward from the game.

***Measures.*** *Empathy.* The IRI measure from Experiment 7 was used.

*Theory of Mind.* The 'Reading the Mind in the Eyes' revised-test (RMIE) measures the ability to recognise the mental state of others using partial facial expressions. The test is comprised of 36 photographs of actors and actresses displaying only the region of the face around the eyes. Participants are asked to choose from four words that describe what the person is thinking or feeling. The words refer to both basic mental states (e.g., sad) and complex states (e.g., arrogant). While the test-retest reliability of the RMIE has not been properly assessed, several studies report high reliability (Fernández-Abascal, Cabello, Fernández-Berrocal, & Baron-Cohen, 2013; Vellante et al., 2013; Yildirim et al., 2011).

*Nonverbal Sensitivity.* The MiniPONS is the short version of the 'Profile of Nonverbal Sensitivity', a measure of the ability to recognise the emotional state, interpersonal attitudes, and communicative intention from various nonverbal channels. The measure consists of 64 brief recordings presented to participants in one of three modalities (videos with sound, videos without sound, or a voice recording only) from the same female displaying an interpersonal scenario (e.g., arguing with someone). Participants are given a choice of two responses that they believe best represented the actor's intentions. The measure has been found to correlate highly with the PONS, which has high validity and reliability (Bänziger et al., 2011; Rosenthal et al., 1979).

*Eye-Tracking.* To measure the eye movement of participants a SensoMotoric Instruments (SMI) RED500 Binocular Eye-Tracker was used. The device was calibrated and set to record using the RED250 interface at 120Hz. The presentation of stimuli, order of tasks, and recording of eye movements was controlled by the experimenter using the SMI laptop. The videos were displayed to an external monitor (1280x960 resolution) which had the eye-tracker mounted underneath. For each participant, a 10-point calibration followed by a 4-point validation process was conducted.

***Procedure.*** Participants were initially given the IRI questionnaire followed by RMIE and the MiniPONS. Afterwards, they were randomly assigned to one of the two postures (Open or Closed) and were placed in front of the eye-tracker. After ensuring the postures were properly adopted, and the calibration and validation of the eye-tracker was performed, participants were shown instructions regarding the first video set, either high-stakes or low-stakes (counterbalanced, and all videos within each set were randomised). All responses were inputted by the experimenter, so that participants held their posture the entire time. After the first set of 18 videos were shown, the instructions for the second video set were displayed. For each video, in both sets, participants had to give two verbal responses: the veracity of the video, and their confidence using a 7-point Likert scale. At the end, participants were asked a few follow-up questions and debriefed.

**Results**

Due to a technical malfunction with the Eye-Tracker, only 32 participants could be recorded, therefore the results presented here form a snapshot of the study's scope and potential; nonetheless, the value of the data to the overall argument was deemed strong enough to include in this chapter.

***Deception Detection Performance.*** The responses from the decoders were coded and analysed using SDT, as in Experiment 7. The response variables for the experiment were A' and B". Overall, the percentage of correctly identified truthful statements was 60% (*SD* = 2.33) and 42.3% (*SD* = 2.03) for lie statements. The difference between truth and lie detection accuracy was significant, $t(31) = 5.75$, $p < .001$, 95% CI [2.44, 5.06], $d = 2.07$.

To see if the results in Experiment 7 would replicate, an initial independent-sample t-test was conducted on Posture and Accuracy (A'). While decoders in the Open posture had higher accuracy ($M = .59$, $SD = .15$) compared to decoders in the Closed Posture, ($M = .55$, $SD = .11$), the results did not reach significance, $t(29.3) = .87$, $p = .39$, 95% CI [-.05, .13], $d = 0.32$ (due to Levene's test being significant, the unequal variance statics are reported). Subsequently, a between-subjects ANOVA was conducted looking at the effect of Posture and Empathy on Accuracy, to separate any the effect that the posture manipulation may have highly empathic decoder compared to low empathic decoders (as per the findings in Experiment 7). A marginally significant interaction was observed between Posture X Empathy, $F(1,28) = 2.97$, $p = .096$, $\eta_p^2$=.096, replicating the findings of Experiment 7. Planned follow-up independent sample t-tests reveal that the effect was present (marginally) only for High Empaths, between Open ($M$ = .63, $SD$ = .14) and Closed postures ($M$ = .51, $SD$ = .10), $t(14) = 1.94$, $p = .073$, 95% CI [-.01, .25], $d$ = 1.03 (see Figure 29).

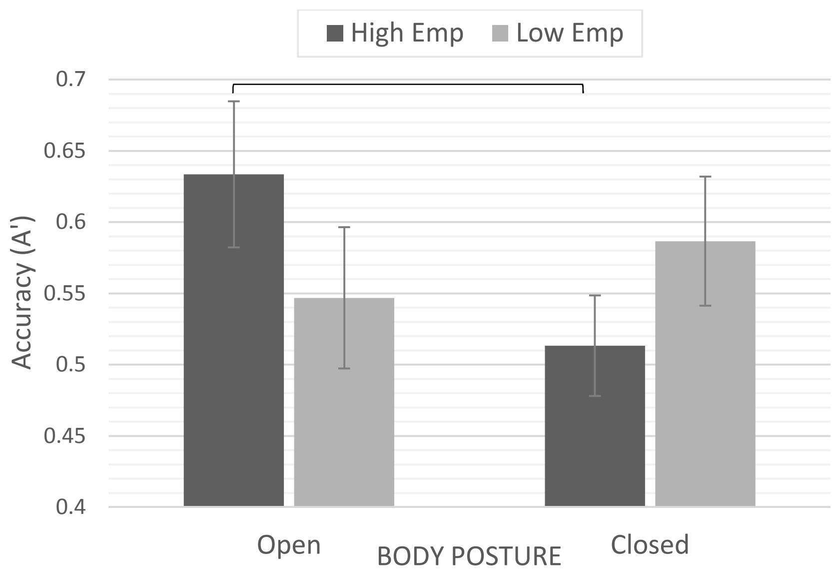


Figure 29. Accuracy in Detecting Deception (A') based on Posture and Empathy groups; the bar represents the marginally significant effect of Posture on High Empaths. Error bars represent SE ±1.

To expand on Experiment 7, the effect of Posture on detecting both Low- and High-Stakes deception was investigated. The ANOVA revealed that the interaction between Stakes and Posture, while in the direction predicted (i.e. Posture aided classification of High-Stakes videos more than Low-Stakes videos), did not reach significance, $F < 1$, ns. However, a marginal effect of Stakes overall was observed, $F(1,30) = 4.04$, $p = .053$, $\eta_p^2 = .119$, suggesting classification of High-Stakes videos was easier than of Low-Stakes videos (see Figure 30).

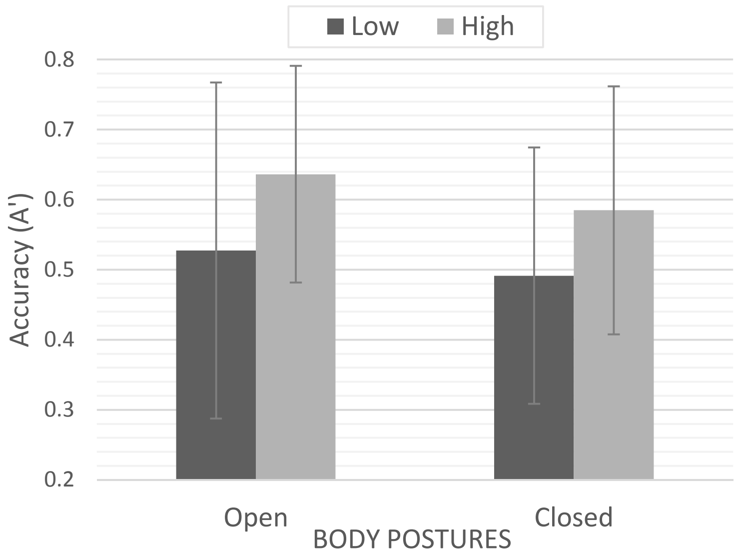


Figure 30. The effect of Open and Closed postures on Deception Detection (A'), in both High-stakes and Low-stakes scenarios. Error bars are ±1 SE.

To understand if the results were influenced by a shift in response bias, an ANOVA on Stakes and Posture was conducted using B" as the dependent variable. The results did not indicate any effects of Posture on response bias, $F < 1$, ns., or Stakes, $F < 1$, ns., nor an interaction $F(1,30) = 2.71$, $p = .110$, $\eta_p^2 = .083$. Adding Empathy to the analysis did not produce any trends or significant results (Empathy, $F(1,32) = 1.15$, $p = .293$, $\eta_p^2 = .039$; Posture, $F < 1$, ns.; Interaction, $F < 1$, ns.). Comparing the bias scores of decoders to no bias (0) reveals that decoders in the Open posture were truth-biased ($M = .44$, $SD = .35$, $t(16) = 5.24$, $p < .001$, 95% CI [.26, .62], $d = 2.62$, as were decoders in the Closed posture ($M = .36$, $SD = .25$), $t(14) = 5.56$, $p < .001$, 95% CI [.22, .50], $d = 2.97$.

***Eye-Movements.*** The eye-tracking data was converted into several dependent variables in the form of Areas of Interest (AOI), representing the body (AOI-1), the upper face (AOI-2), the lower face (AOI-3), and hands (AOI-4). These were categorised based on dwell time—time spent looking at the specific area—and as a percentage of total AOI—total time spent looking at the specific area divided by the total looking time of all areas. A Fixation Count variable was also created measuring the number of times decoders fixated on each target area.

To understand what may be driving these Posture effects on accuracy it is important to look at difference in gazing behaviour between decoders. To this effect a series of independent sample t-tests were conducted to uncover potential difference in Average Dwell Time (in sec), Average Dwell Time (as a percentage), and Average Fixation Count. An initial analysis separating the effects based on Empathy (High vs. Low) reveals that significant effects are only present in High Empaths, with no effects or trends present in Low Empaths (all $p > .30$). Thus, all subsequent analyses refer to the High Empaths only.

Looking at each videos set, High-stakes ($M$ = 1.74s, $SD$ = 1.33s) and Low-stakes ($M$ = 3.22s, $SD$ = 5.01s), a significant difference in looking time was revealed, $F(1,27) = 312.15$, $p < .001$, $\eta_p^2 = .92$. This is to be expected as there were significant differences between the videos sets themselves, such as in the Low-Stakes videos the senders were standing, while in the High-Stakes videos the senders were sitting. However, no interactions were found; therefore, no further analyses are reported using Stakes.

Planned t-tests revealed a significant effect of Posture on the Average Dwell Time, with decoders adopting the Open posture looking less at senders ($M$ = 4.5s, $SD$ = 1.4s) than decoders in the Closed posture ($M$ = 5.9s, $SD$ = 0.3s), $t(7.63) = 2.81$, $p = .024$, 95% CI [-2.5, -0.2], $d = 2.03$ (unequal variance statics are reported). Similar results were obtained for the Percentage Average Dwell Time, with the Open posture decoders spending a smaller portion of overall time looking at the senders ($M = 16.9$, $SD = 5.4$), than decoders in the Closed posture ($M = 21.9$, $SD = 1.1$), $t(7.63) = 2.56$, $p = .035$, 95% CI [-9.54, -0.45], $d = -1.85$, (unequal variance statics are reported). Lastly, no difference in posture were found for High Empaths in terms of Average Fixation Count, $t(14) = .80$, $p = .436$, 95% CI [-5.60, 2.55].

To better understand the potential subtle differences in looking areas between decoders in different Postures, independent sample t-tests were conducted separating the AOI of the Body (AOI-1), Face (AOI-2 + AOI-3), and Hands (AOI-4). The single effect that suggested a difference in looking patterns between Postures was for decoders in the Open posture looking less at the hands ($M$ = 0.46s, $SD$ = 0.28s) than decoders in the Closed posture (*M* = 0.81s, *SD* = 0.50s), *t*(22.4) = 2.48, *p* = .021, 95% CI [-634.07,-56.84], *d* = 1.05, indicating that decoders in the Open posture devoted less time to this source of information.

***Confidence.*** In Experiment 7 confidence was not measured directly, it was prudent to uncover if the Posture manipulation influenced the confidence decoders had in their ability to detect deceit. Independent sample t-tests were conducted on both confidence of all decoders and that of High and Low Empaths separately, with respect to Posture. The analyses did not find and significant difference or trends in the data, either for overall, *t*(30) = 1.23, *p* = .227, or based on high empathy, *t*(14) = .71, *p* = .487, or low empathy, *t*(14) = .90, *p* = .382. Additionally, running Pearson's correlations for Confidence and Accuracy did not uncover any significant relationships, (high-stakes) *r*(32) = -.163, *p* = .371, (low-stakes) *r*(32) = -.051, *p* = .783.

***Nonverbal Sensitivity.*** Considering the MiniPONS or the RMIE scores as a covariate in the Posture analyses (overall and with Empathy) did not reveal any significant effects. Moreover, even comparing accuracy for High and Low stakes (due to the theoretical difference in amount and intensity of behavioural cues present in such scenarios) did not produce any noteworthy findings. Furthermore, neither nonverbal sensitivity measure correlated with empathy, suggesting they reflect different interpersonal concepts.

**Discussion**

The results of this experiment expand the findings of Experiment 7, and replicate some important aspects. While the reduced sample size greatly affects the reliability and interpretability of the data, it nonetheless adds important information for the passive lie detection approach proposed.

In terms of accuracy, a trend towards replicating the effect of Experiment 7 was observed, as decoders adopting an Open posture had a (tiny) 2% improvement, which was further increased when looking at High Empaths, reaching a marginally significant 12% difference. This suggests that, as with Experiment 7, the posture manipulation is felt more strongly by individuals that have higher trait empathy. This would be in line with the current assumption that adopting an open posture relates to the way individuals perceive and process social information from others.

The effects that Posture and Empathy have on accuracy cannot be investigated in the absence of considering response bias, as this is a major component of deception research. At present, the results find that response bias is not affected by the posture manipulation, which is ideal for an intervention study, indicating that the change in accuracy is not artificially created by a shift in the response tendencies of the decoder. However, all decoders in the present study still remained truth-biased, regardless of the type of videos they were decoding or individual differences. This does not necessarily detract from the impact of the effect, but it is important to consider.

In the same vein, it was found that confidence in veracity judgements was not impacted by the Posture manipulation. This is an important manipulation check, as in Experiment 7 it could have been claimed that the Open posture affected perceived power (Carney et al., 2013), thereby influencing perception of decoding ability and decision making. This was initially discounted due to a lack of gender differences in Experiment 7 (as power postures tend to influence men more; see Carney et al., 2013), and lack of difference in bias; Experiment 8 adds support this interpretation.

The important addition of Experiment 8 was the use of eye-tracking to investigate the source of the posture effect. It was aimed at separating a difference in gazing behaviour (i.e. does an Open posture lead to differences in attention) to those of information processing (i.e. does posture make decoders more analytical). The analysis comparing the looking pattern of decoders, both in terms of location and time spent, revealed that Posture overall did not influence gazing behaviour directly. However, when separating decoders based on Empathy, it was found that High Empaths in the Open posture showed a decrease in overall dwelling behaviour (i.e. time spent on a specific area), but no difference in the number of times they fixated at each location. Additionally, High Empaths tended to look less at the hands than decoders in the Closed posture. These effects were not seen for Low Empaths.

Conversely to what was anticipated, adopting an Open posture results in less attention being given to the nonverbal behaviour of senders, both in terms of time and areas of the body. This taken together with the accuracy difference would suggest that either decoders in the Open posture rely less on behavioural information for their veracity judgements, or do so much quicker and/or efficiently.

**General Discussion**

In this chapter, two experiments were presented that investigated a passive lie detection technique aimed at improving accuracy: having decoders adopt specific body postures that reflect openness to communication. The experiments combined research from embodied cognition, social acuity, and emotion recognition, to produce a novel method of improving accuracy without the use of training or manipulation of the stimuli.

In Experiment 7, the results revealed that adopting an Open posture can facilitate the detection of deception, resulting in higher discriminability between the two veracities (especially for truthful statements). This effect was more visible in High Empaths, which showed the highest detection accuracy while adopting the Open posture (68%). This is an optimistic finding as the natural variation of accuracy in deception studies is between 44% and 65% (Bond & DePaulo, 2006; Levine, 2014a).

The lack of an improvement for detecting deceptive statements may be explained by the lack of behavioural cues present. As the lies were low-stakes in nature, senders would not have experienced strong emotions relating to their lies (i.e. lack of leakage cues), making classification difficult as decoders had little information to utilise, even if the posture manipulation aided perception. Therefore, if the open posture truly aids accurate recognition of behavioural cues, then it requires the presence of cues for it to provide a benefit.

Subsequently, the result of the facial expression recognition task did not indicate any effect of Empathy or Postures, suggesting no benefit of being higher on trait empathy when it comes to accurately recognising facial expression of emotion, or adopting an open posture. Although previous research has indicated a positive link between empathy and facial expression recognition (e.g., Carr & Lutjemeier, 2005), the current methodology investigated the recognition of microexpressions (brief flashes of prototypical expressions) whereas most studies use the recognition of facial expressions based either on valence (positive-negative; Martin et al., 1996) or presented for longer periods. As was argued in Chapter 5, the empathic process may not have affected recognition for such brief expressions, supporting the assertion that empathy does not facilitate subtle cues recognition.

Experiment 7 provides initial evidence for a postural effect resulting in an improvement in deception detection in the absence of training or manipulation of the testing conditions; demonstrating that an Open posture can produce a beneficial effect in detecting deception. Furthermore, the results show that this improvement in performance is not attributable to a shift in response bias brought about by the manipulation, as overall all decoders were truth-biased in their judgement.

Two potential explanation were proposed for the effect: (1) postures, as they relate to openness to communication, might be influencing the visual attention that decoders were giving to the stimuli. Adopting an Open posture might have influenced where decoders were looking (e.g., looking more at the face of senders) compared to when they sat in a Closed posture (e.g., ignoring visual information altogether); (2) posture may be influencing the amount of cognitive resources being dedicated to processing the available information, resulting in improved information processing of genuine and deceptive statements (as posture 'signals' the decoder to attend to social information).

Experiment 8 investigated these hypotheses by incorporating both High and Low-Stakes stimuli and an eye-tracker to assess looking behaviour of decoders in the various postures. The addition of multiple video stimuli can demonstrate the stability of the posture effect across multiple lie scenarios, and potentially demonstrate if the presence of more nonverbal cues aids the decoding process.

The results provided support for the passive lie detection approach, replicating the improvement in accuracy due to both posture and empathy. The eye-tracking data serve to answer this question further, by detailing gazing differences between the decoders. It was found that highly empathic individuals when placed in an open posture spend less time gazing at the senders in the videos. This effect suggests that, contrary to the assumption of the posture effect, decoders adopting this posture do not attend more to or 'scan' their targets more thoroughly, they actually devote less time focusing on the sender, compared to individuals adopting a closed posture. This was further supported by the fact that high empaths in the open postures also focused less on the hands of the senders in the videos.

This second finding might aid in explaining the overall effect. Decoders in the closed posture, as it relates to being socially withdrawn, may be less inclined to look at the face or body of a person as this can signal a desire to interact, while gazing at the hands does not signal such a desire. For decoders in the Open posture, the fact that they focused less on the nonverbal behaviour of the senders may reflect two different explanations: (1) they were more efficient at decoding nonverbal signals, and thus required less time looking at the source, or (2) they diverted resources to processing other sources of information, such as verbal information. This second explanation implies that the posture relates not specifically to improved nonverbal sensitivity but to increased information processing of other sources. Currently, it is difficult to separate the two explanations.

The eye-tracking data, while answering certain questions, raises multiple as well. The difference between postures and gazing behaviour do suggest that the manipulation has a strong relationship to how decoders perceive others, and how they process the information they receive. However, the inverse direction from what was anticipated suggests that the way interpersonal information is processed may be more important than attention to behavioural cues, at least for deception detection.

The above explanation is corroborated by the fact that neither the posture or empathy manipulations had any significant relationships with the nonverbal sensitivity measures. Adding these findings to the facial recognition result in Experiment 7 would indicate that postures and empathy relate to deception detection due to the way it influences decoders' processing of information they perceive, not by increasing the amount of cues detected. The literature on postures does seem to suggest this assumption is valid, as compatibility between posture and situation has been shown to facilitate performance by increasing availability of processing resources (Barsalou, Niedenthal, Barbey, & Ruppert, 2003) and facilitating retrieval and comprehension (Förster & Strack, 1996; Riskind, 1983).

The lack of both any significant relationship of either the MiniPONS or the RMIE with deception detection or empathy would indicate that while all fall under the umbrella term of interpersonal sensitivity or nonverbal sensitivity they do not overlap as concepts. Emotion recognition, as was defined in Chapter 3 and 5, is a board concept relating to the ability to infer the emotions of others via nonverbal, verbal, and paraverbal displays. The RMIE measures the ability to discern mental states from facial expressions, while the MiniPONS measures the ability to understand intentions and the affective states of others from multiple nonverbal channels. This difference may be at the core of the relationship (or lack thereof). Empathy may relate more to the processing of emotional information than to its perception from nonverbal sources.

In light of the accuracy results, this seems to form the picture that processing of available information is more important to detecting deception than is increasing perception of cues. Of course the absence of cues would mean there is nothing to be processed, which would explain why truth detection seems to be the affected component of the detection process, as in everyday conversation people will involuntarily display the affective states that match their statements. Using a manipulation such as posture to improve processing of social information combined with the empathic accuracy of interpreting the emotional information results in a benefit in detecting genuine statements. This is also supported by the trend towards high-stakes videos (which are argued to contain more genuine cues) being discriminated with higher accuracy.

The data presented suggests that certain postures facilitate information processing under certain conditions. If the decoders adopted a mentality of openness to communication then it would be fair to assume this would dedicate more resources to processing incoming social information. However, where these resources are allocated to—demeanour or verbal information—is something that requires further investigation.

The explanation for the posture effect is that open and closed postures are an embodied concept relating to openness-closedness dimension of social interaction (Mehrabian & Friar, 1969). By adopting an open posture individuals prepare themselves to receive social information, facilitating the interaction/communication process (Wood, Saltzberg, & Goldsamt, 1990). Adopting a closed posture would result in social information being ignored or processed to a lesser extent, as the posture is signalling the adoptee that they are not interested in social interaction and are socially “closed off” (Schwarz & Clore, 1996). The results are in line with past research relating to embodied cognition (Briñol & Petty, 2008; Briñol, Petty, & Wagner, 2009), and provide support for the new proposition that certain postures affects the way one processes deception related information. This data supports the interpretation that the posture manipulation influences interpersonal information processing, resulting in an appreciable improvement in accuracy. An open posture, as the name suggests, is both perceived and adopted automatically when individuals feel relaxed, and open to interactions (Machotka, 1965), and will prepare individuals to be more responsive and attentive to social cues.

The effect of open posture shows a novel method of improving accuracy without the need for training with cues or lengthy practice. It suggests that simply adopting a specific posture can influence accuracy of determining veracity, without it biasing judgement. This effect has many practical implications, relating to security, law enforcement, or clinical psychology. For example, in many countries the defendant or suspect cannot be forced into providing evidence against themselves, and thus cannot be compelled to comply with an interrogation tactic based on a lie detection techniques, such as those proposed by the cognitive interview. Using the passive lie detection approach ensures that the suspect needs not agree to any additional requirements or procedures. In a security scenario, interrogators may adopt an open posture to improve the odds of discriminating the veracity of statements. Similarly, psychiatrists may benefit from a posture that improves recognition of truthful cues, as it allows for a better understanding of their patients emotional states.

It should be noted that the effect of empathy on deception detection reported was fairly small, implying that empathy may not have such an impactful role in accuracy. Nonetheless, the effect found is in line with past research and does warrant further attention, especially considering the information processing explanation put forward for the effect of postures on accuracy. Overall, empathy seems to have an integral role in detecting deception.

Unfortunately, comfort levels of each posture was not assessed in either experiment. Studies have linked different postures to varying degrees of comfort (Mehrabian, 1969; Rossberg-Gempton & Poole, 1993). Adopting a certain posture, like the closed condition, may have increased physical discomfort resulting in a decreased performance on the tasks. Similarly, discomfort may have been caused by attempting to maintain the instructions of each posture, influencing the availability of mental resources to devote to the task. Although this notion does not detract from the observed effect, especially as there was no decrease in accuracy due to the posture manipulation below what has been reported in the literature (i.e. 54%; even in the Closed posture), replications should collect information to ascertain the comfort level of the postures, for a better understanding of the underlying mechanism.

One difficulty in understanding the mechanism of this effect is whether posture influenced how much participants 'want' to interact with their surroundings or their ability to do so. The increase in accuracy seen in the Open posture would suggest that the manipulation aided deception detection above what is normally seen in such research, as the Closed posture did not hinder accuracy (i.e. a decrease was not driving the accuracy finding).

Therefore, the posture manipulation had the benefit of not producing any negative utility for detecting deception, as Levine (2014a) refers to it. Multiple intervention studies attempting to improve detection accuracy through various methods have actually produced below chance accuracy after their interventions, which must always be avoided (e.g., Levine, Blair, & Clare, 2014; Levine, Kim, & Blair, 2010).

An extension for future research into this passive lie detection method is using interactive settings, such as adopting this posture during an interrogation with a suspect (as in Experiment 6). This would extend this effect to the sender (i.e. liar), as studies have found mimicry can influence the behaviour of liars and truth-tellers in an interrogation setting (Shaw et al., 2015). In an optimistic prediction, the effect of open posture would fosters relationships and facilitate affiliation (Lakin, Jefferis, Cheng, & Chartrand, 2003). If the decoder and sender where in a similar embodied state (i.e. exchange information accurately; especially for truth-tellers) they would activate similar cognitive and affective states (Barsalou et al., 2003), enhancing empathy and rapport (Chartrand & Bargh, 1999; Lakin & Chartrand, 2003; Stel et al., 2008), resulting in even higher detection of genuine statements.

Implementing the passive lie detection approach would be a simple and efficient method that would have the benefit of not hindering the police interrogation process. For example, in the UK interviews are often conducted with more than one investigator present in the room (Sim & Lamb, 2012), as are those in human intelligence interviews (Soufan, 2011). Indeed, interviews typically involve one police officer asking questions while the other one silently takes notes (Shaw et al., 2015). In such scenarios it would be worthwhile to see if manipulating the posture of the silent interviewer would facilitate their ability to detect deception in a live interrogation.

If decoders in the Open posture showed improved processing of behavioural information, it is important to understand what information was processed more efficiently, or which type was given more weight. The consistent effect of empathy, although weak, shows support for this notion, as it relates specifically to the processing and understanding of another's emotions (Kana & Travers, 2012). Combining the methodology of the current posture manipulation with the stimuli from Experiments 4-5 may provide valuable insight, uncovering if authenticity discrimination improves.

Another method of decomposing the effect in terms of behavioural cues is to modify the deception stimuli into audio, video, or audio-video conditions. This may indicate where the effect is most influential, splitting verbal (and paraverbal) from nonverbal cues. However, research reports that deception detection accuracy is much lower for just audio presentations, while it being much higher when video is also included (Bond & DePaulo, 2006; Stiff et al., 1989), which may complicate the interpretation of the results.

***Conclusion.*** In conclusion, the results presented in this chapter find support for the passive lie detection approach, finding that adopting an open body posture facilitates deception detection. This effect seems to indicate a relationship with empathic perception and information processing. The Open posture manipulation was successful over two studies and seems to suggest it generalizes across low- and high-stakes deception. Additionally, considering the difference in looking time and attention to specific areas of behaviour uncovered in the second experiment would suggest that the posture manipulation relates to how quickly and efficiently behavioural information is processed, and not which behaviour is attended to. It seems the manipulation is predominantly beneficial for decoders that are highly empathic, suggesting the effect of openness to communication relates to the same process proposed in Chapter 5 relating to facilitating communication. This is supported by the fact that lies did not seem to be as affected by the manipulation, suggesting that information processing aids detection predominantly for genuine communication. As it stands, this is the first exploration into passive lie detection using postural states, suggesting that accuracy can be improved in the absence of extensive procedural manipulation or training in cues.

# Chapter 9: Overview of Research Findings

Lying is pervasive in social interactions (Feldman et al., 2002; cf. Serota & Levine, 2014) serving to facilitate relationships and increase self-gain. For the people being lied to, while in many scenarios might want to ignore the lies told to them, avoiding a 'harsh truth', in other instances it is paramount that they know the veracity of what is said (Knapp, 2006).

In itself, the process of deceiving is a highly complex endeavour (Vrij, 2008; Zuckerman, DePaulo, et al., 1981). Nonetheless, the ability to deceive is quite effortless in application, especially considering the high success rate of lies (Bond & DePaulo, 2006). That is, people can lie with great ease, and are rarely caught in the act (Park et al., 2002).

## The Role of Emotions in Deception

Why is deception detection such a difficult task? This has be the underlying theme of the current thesis. To answer this question, I have focused on a specific area of the deception field, the role of emotions in both deception and detecting deception. Emotions are an integral aspect of human communication and for deception. An entire branch of the deception detection literature, arguably the most influential, has developed around the notion that the emotions experienced by liars and truth-teller can be used to separate veracity, referred to as the emotion-based approach to deception detection.

Research has provided evidence for several key aspects of the emotion-based approach. Emotions are expressed by individuals in an almost universal way and recognition of such emotional displays is very high (Ekman et al., 1987; cf. Barrett, 2011; Crivelli, Jarillo, Russell, & Fernández-Dols, 2016). Second, liars experience strong emotions relating to their lies which truth-tellers do not experience (Ekman, 2003a). Third, liars will leak their genuine emotions during deceptive episodes (ten Brinke et al., 2012). Forth, behavioural information can be used to classify veracity (Van Der Zee et al., 2015), such as emotional cues (Frank & Ekman, 1997).

While these findings start to form an image of emotions being used to ascertain deception, research that focuses on this approach and using human decoders find that accuracy is quite low. Furthermore, training to use emotional cues does not produce an appreciable increase in accuracy. This inconsistency has plagued deception research since its nascence, to such an extent that many have moved beyond the emotion-based approach to pursue other methods of detecting deceit (see Vrij, 2008). I argue that it is premature to reduce the field by such a degree. This could have negative consequences on our understanding of veracity judgments and the importance emotions have to detecting deception (for a detailed critique of the overreliance on the cognitive method, see Sporer, 2016). It has been argued that emotions are not a valid source of deception related behaviour as they tend to be scarce (DePaulo et al., 2003), and even when present, they do not reliably aid detection (e.g., Porter et al., 2012). The aim of this thesis was to understand what is causing the low accuracy reported when human decoders rely on emotional information.

My thesis contributes to the emotion-based approach to detecting deception by demonstrating that decoders have a negative relationship between their ability to decode emotional information and detecting deception in the majority of scenarios, which may be attributed to their inability to distinguish genuine from deceptive cues. This perspective offers significant insight into the way individuals make veracity judgements, providing new theoretical and practical avenues for research to follow. Importantly, it offers an explanation for why human decoders produce such low accuracy scores when made to use emotional information, challenging the current predominant belief that emotional cues are not relevant to the decoding process because they are ‘too rare’.

**Summary of Research**

This thesis expands the current understanding of emotions in deception, moving away from the traditional belief that emotions are a source of information which decoder should be able to use to determine a sender’s honesty, asking the question of: how do emotions relate to the way decoders make veracity judgements?

To address this, I tested the assumption that decoders can utilise subtle nonverbal information, such as facial expressions, to accurately determine veracity. My prediction from the start has been that for human deception detection (i.e. judgements made by individuals interacting with senders or watching videotaped statements) emotions aid truthful communication but hinders the detection of deceptive communication. From this premise I conducted a series of experiments, relying on methodology and frameworks from multiple sub-fields in psychology, tackling the question from multiple directions.

In this chapter, I will briefly summarise my research, detailing the contributions of each experiment to the overall aim of the thesis. Subsequently, I will discuss the contributions of this research to the deception and emotion fields, as well as discuss avenues of potential future research that can be generated from these findings. I will argue that emotions play an important role in human veracity judgements, that it is more complex than previously reported, and that it should not be ignored as a factor due to the limited applicability reported by past research.

In addition to the theoretical perspective offered by my thesis, I offer novel contributions to the understanding and methodologies used in the field of deception and emotions. First, the research clarifies and expands the relationship between emotion recognition and deception detection ability, finding that being better at inferring the affective state of other does not result in better accuracy (Experiment 2: Emotion Recognition in Low-Stakes), even when the statements are emotional in nature (Experiment 3: Training and Deception Detection).

This finding goes against the core belief of the emotion-based approach, which suggest the better a decoder is at perceiving emotional cues (e.g., facial expressions), and interpreting their meaning (e.g., empathy) the better they should be at detecting honest from deceptive statements. I find this relationships between accuracy and emotional cue recognition is non-existent (as seen from the failed relationship of both microexpressions and subtle expressions; Experiment 2-3, and 7 (Body Postures, Facial Expressions, and

Deception Detection)), while for more abstract emotion recognition abilities negative in terms of veracity judgements (as seen from the empathy relationship; Experiment 2-3).

Second, the current research provides an evidence based argument for the amount of control that individuals have over their facial expression production, suggesting that emotions can be used to aid a deceptive statement (Experiment 4-5: Producing Deceptive Expressions). This research illustrates that the reason for the inconsistent relationship observed with accuracy may be attributed to the ability of senders to voluntarily produce genuine-looking deceptive emotional displays.

Third, in this thesis I presented evidence for the role of situational factors on the entirety of the deception process, arguing that deception research must address factors that can impede the accurate decoding of sender's statements, and ensure that we are not negatively influencing the ability of the sender to portray themselves in a clear and accurate manner (Experiment 6: Situational Factors – Handcuffing).

Finally, a novel understanding of how to improve deception detection using embodied states reveals that information processing may be more important for accuracy than facial cue detection. The data show that deception detection can be improved using non-invasive techniques, which do not require that the method of collecting statements or training of the decoders be affected (Experiment 7-8).

In light of the current findings, I will suggest that accuracy in detecting deception based on emotional cues has been poor due to the inability of lay decoders to separate genuine from deceptive emotions, leading to an erroneous belief that the liar is being honest in their affective displays. Although the scarcity of emotional cues in deception is still considered a valid argument, which has not been disproven or contradicted presently, it is not the only factor influencing the accurate perception of sender veracity or of the decision-making process. Emotions are still an integral aspect of perception and the decoding process.

**Experiment 1: Multi-Decoder Deception Detection**

The premise of this chapter and its aim stemmed from my initial perception and intuition regarding the deception detection field. The experiment outlined in this chapter was developed primarily to test the 'rational decision-maker' perspective that much of the deception field proposes when arguing for intervention methods. While researchers are aware that biases exist in decodes' judgments, they tend to attribute this to a heuristic used *in the absence* of information, namely, the inability of decoders to perceive behavioural cues from senders. The aim of the experiment was to understand why even multiple decoders when making joint decisions are not more accurate, but more lie-biased and confident in their judgements (Frank et al., 2004; Park et al., 2002).

If a single decoder has poor perceptive ability then multiple decoders should, theoretically, each be able to provide a piece of the puzzle to reach a correct judgement. However, this has not been found to be the case, and past research provided no mechanism to account for the differences in response bias observed. I implement a design from small-group decision-making research to understand these effects by manipulating the amount and type of communication (LoC) decoders could share before their joint decision, focusing less on accuracy per se, and more on the source of the bias and confidence effects.

It was found that when decoders work together their ability to detect deception does not improve, yet their confidence in their decisions increases. Furthermore, this overconfidence of pairs was stronger the more members of the dyad communicated (LoC). Interestingly, when decoders in pairs were forced to justify their answers using a predetermined list of reasons (Reason condition) their performance improved, suggesting that providing a list of possible behaviours decoders to focus on reduced their truth-bias. Overall, it suggests that multi-decoder deception detection does not improve upon, and may even impair, the poor performance of single decoder methodologies.

**Experiment 2: Emotion Recognition and Low-Stakes**

Lay beliefs suggest that there is a strong relationship between facial expressions and 'tells' for deceit (Levine, Serota, et al., 2010). While some have argued this is due to culture and social learning (Bogaard et al., 2016), there is an extensive corpus of deception research asserting the importance of facial expressions in detecting deception (Ekman, 1999, 2003a). However, no conclusive data has been presented to favour this relationships.

Testing this core assertion of the emotion-based approach, this experiment uncovered an inverse relationship between empathy and the ability to detect deceptive statements, and no relationship with between facial cue detection and accuracy. At first glance the results may not seem very striking, as many deception studies have found that individual differences are not related to accuracy (Aamodt & Custer, 2006). However, this would be the case if no relationship was found at all. For example, decoders were able to accurately classify microexpressions and subtle expressions with decent accuracy (~63%; where chance performance was 14.3%), but did this not translate into a positive relationship with detecting deception. This suggests that, contrary to the assumption of the emotion-based approach, being able to detect microexpressions and subtle expressions does not relate to accuracy in detecting deception. Therefore, differences in decoder sensitivity to cues is not the issue driving poor performance. However, the negative relationship between empathy and lie detection suggests that being more attuned to the emotions of others (that is, being empathic) is detrimental to discerning veracity. After accounting for bias, it seems to suggest that lower empathy makes people rely less on emotional information, potentially being more analytical of the sender's message, resulting in better detection.

**Experiment 3: Emotion Recognition Training in Low-Stakes and High-Stakes**

An important factor in deception research is the stakes surrounding the lie told, which are said to influence the production of emotional cues. The second experiment assessed this assumption of the emotion-based approach, alongside differences in decoder ability and knowledge of emotional cues. I trained decoders' ability to perceive emotional cues to test the assumption that accuracy can be increased through training (Ekman et al., 1991; Frank & Ekman, 1997). This extended the findings of Experiment 2, by uncovering if perhaps emotion recognition has an optimal/necessary level of cues required for a positive interaction (i.e. if too few cues are present then decoders erroneously use emotional information, but if cues are abundant emotion recognition becomes useful).

The results of this study confirmed the lack of relationship between emotional cue recognition and accuracy, and further extended the finding to emotion-based training and high-stakes lies. The results relating to HSE truths and lies supported the claim that leaked emotions are a source of veracity, while stakes to the liar alone do not improve accuracy. This chapter provided evidence for my proposition that decoders are able to use emotion based information to detect veracity only if it reflects genuine affect.

**Experiments 4-5: Producing Deceptive Expressions of Emotion**

Chapter 6 presented research testing the hypothesis that low deception detection using the emotion-based approach is partly due to decoders not being able to separate deceptive from genuine emotional cues. In both experiments it was found that decoders were accurate in detecting genuine expressions of surprise (63% in Experiment 4 and 58% in Experiment 5, where chance was 33%), however, they were not as good at detecting deceptive expressions if produced after the sender had a recent experience with the genuine expression (Experiment 4: Rehearsed vs Improvised), especially knowledge of the external display of the emotion (Experiment 5: External vs Internal). These experiments confirm the assumptions made from the previous data, that decoders are not adept at separating genuine from deceptive emotional cues.

**Experiment 6: Situational Factors in Deception Detection**

Expanding on the scope of the research, I focused on the effect that behavioural information can have on the deception detection process. As the data thus far has indicated that although accuracy is not improved for decoders relying on behavioural cues (such as facial expressions) such information significantly impacts veracity judgements.

To demonstrate the impact that artificially interfering with the natural behaviour of liars and truth-tellers I utilised a simple mobility restricting manipulation—handcuffing suspects—to uncover if reducing the ability of senders to freely gesticulate during a police interrogation would impact the ability of honest senders to portray themselves accurately. Additionally, the potential biasing effect that the presence of a salient cue to criminality (i.e. the handcuffs) could have on the interrogator conducting the interrogations and on the laypersons and police officers watching the recording of the interrogations at a later time were considered (e.g., Landström, Af Hjelmsäter, & Granhag, 2007).

While the study was exploratory, the predictions that handcuffing suspects would affect the veracity judgements of detectors were supported. Handcuffing suspects during an interrogation results in marked differences in both their behaviour and speech, but also in the perception of decoders regarding the veracity of their statements.

It was found that the interrogator's ability to detect truthful statements was impaired. For laypersons their ability to detect deceptive statements from handcuffed suspects decreased, while their bias towards believing their statements were honest increased. Police officers showed no influence of handcuffs on judgement (accuracy or bias), however, overall their discriminability was lower than that of laypersons, were overconfident, and showed no response bias. This data served to demonstrate that while behavioural information may not be a source that decoders can pursue for improved accuracy under normal circumstances, it is still an important and influencing factor in their veracity judgements.

**Experiments 7-8: Body Postures, Emotion Recognition, and Accuracy**

Behavioural cues, such as facial expressions, may not result in improved accuracy for lay decoders or even trained professionals, but if they do contain useful (and potentially diagnostic) information, it should not be discounted in its potential to improve accuracy. To this effect, I introduced a novel method to improve the ability of the decoder to perceive and utilise behavioural information, utilising postural manipulations.

Experiment 7 presented a *passive lie detection* method aimed at improving accuracy in detecting deception. The goal was to investigate using open and closed body postures on the ability of decoders to accurately interpret the behavioural information of senders. The manipulation demonstrated that decoders, without any prior training or intervention, were able to more accurately discriminate the veracity of senders by simply adopting an open posture.

This effect was replicated in Experiment 8 and expanded to high-stakes scenarios. Furthermore, using an eye-tracker it was revealed that the posture manipulation had a significant impact on the way decoders attend to and processed information from senders. The results suggest that the effect of posture can be attributed to the influence it has on how interpersonal information is processed by decoders, and not their ability to attend to or perceive more nonverbal cues.

In summary, the research contained in this thesis presents a new perspective on the role emotions have in deception, ranging from veracity judgements, sender cue production, external influences on this relationship, and to methods of potentially utilising such information to aid detection. In contrast to the primary assumption of past emotion-based research, it illustrates that emotions can have a detrimental role in uncovering deceit. Additionally, using facial cues to aid detection seems to be a fairly difficult task for decoders, not producing any improvements in performance. The explanation that seems to arise from the data is that deceivers have the ability to voluntarily produce facial expression (i.e. deceptive cues) to aid their lies. This would suggest that emotional cues are not useful in discriminating veracity as decoders are unable to separate genuine cues from deceptive cues. Furthermore, it seems that individuals that are more empathic towards others show an additional decrement that results in their ability to detect lies being impaired, suggesting they may be misclassifying deceptive cues as genuine.

# Chapter 10: General Discussion

## Emotions and Deception

After having provided a summary of the main findings of each experiment, I will discuss the contributions and implications of this research on the fields of deception and emotion. I believe that the findings presented here add value to explaining the role of emotions in veracity judgements, and for how future research is conducted.

I will interpret my research based on the current assumptions and findings of the deception literature, and consider the mechanisms suggested by the emotion research literature, attempting to bridge the gap between the two, forming a unified understanding of how veracity judgements are shaped by the presence or absence of emotions, and the differences in decoders' ability to perceive and interpret emotional information.

***Emotional Cues.*** Deception is often accompanied by the neutralising and masking of genuine emotions, simulating unfelt emotions, and subtle displays (leaks) of the genuine underlying emotions of the sender. These four categories have been important in the literature for separating the type of emotional information that is present in communication. For deception, one category is at the core of the emotion-based approach: leaked emotions. It is suggested that facial muscle activity cannot be completely inhibited (Hurley & Frank, 2011), while certain facial muscles cannot be voluntarily activated (Ekman, 2003a). These are the fundamental components of the inhibition hypothesis (Ekman, 2003a). Research has indeed found such cues are present in deceptive scenarios and ubiquitous in communication (ten Brinke et al., 2012). Therefore, the question remains why is it that decoders do not benefit from utilising emotional cues to detect deception?

The research presented in this thesis demonstrated that decoders are adept at recognising facial expressions of emotions beyond chance level (Experiment 2), however, seem unable to apply this skill to decoding accuracy. This recurrent finding is attributed to the lack of emotional cues, such as facial expressions, in most deceptive scenarios as liars rarely experiences strong emotions which could ‘leak’. This is a potentially justifiable perspective as in Experiment 3 it was found that while overall HS lies (44.6%) were not detected significantly better than LS lies (55.35%), HSE lies—where senders were attempting to mask their true emotions—were classified with higher accuracy (57.4%; compared to 31.9% for HSU), suggesting that emotional leakage could potentially aid decoders in assessing veracity. My argument is that this apparent contradiction—that emotion recognition hinders lie detection, but presence of suppressed/masked/leaked emotions result in improved detection—can be interpreted by considering how all emotion-related information is interpreted by human decoders: they assume that all emotional information is honest, unless otherwise prompted. This assertion is supported by the findings of the experiments on deceptive facial expressions in Chapter 6.

**Deceptive Emotional Control**

Out of all nonverbal channels, people dedicate significant attention to perceiving others’ facial expressions (Noller, 1985). Moreover, people give preferential attention to facial information relative to other nonverbal channels. That is, when there is conflicting or mixed information communicated via different channels of communication information from the face tends to carry more weight (Carrera-Levillain & Fernandez-Dols, 1994; Fernández-Dols et al., 1991; Mehrabian & Ferris, 1967). Importantly, accuracy in recognising facial expressions is higher than recognising other expressive information (Fridlund et al., 1987).

Early research on genuine smiles reported that there are reliable muscles which only activate if the emotion displayed is genuine (e.g., the zygomatic major and the orbicularis oculi in genuine smiles). In addition to this, Ekman claimed that voluntarily (deceptive) expressions will have different characteristics in terms of fluidity, timing, smoothness, and intensity allowing for a clear demarcation with genuine expressions (Ekman, 2003b). However, such claims have recently been called into question with research demonstrating that even voluntarily produced expression can bare the hallmarks of genuine expressions, while involuntary smiles can occur in the absence of activating all proposed 'reliable' muscles (Krumhuber & Manstead, 2009).

The results from Experiment 4-5 suggest human decoders, even in situations where they are asked to judge the veracity of an emotional expression (something that would not naturally occur in normal conversation) are poor at distinguishing the authenticity of facial displays. The implication being that emotional cues are not useful for the classification of veracity, as decoders can misclassify deceptive (voluntary) expressions as genuine (involuntary) expressions. Taking the current results of low discriminability with the findings by Krumhuber and Manstead (2009) of no reliable facial muscles would suggest that liars are much more in control over the production of emotional cues to suit their lies. This is the premise of the *Deceptive Emotional Control* (DEC) hypothesis proposed by the current thesis to explain why the emotion-based approach to detecting deception has produced such weak results.

DEC, I propose, reflects a much stronger ability than previously assumed of individuals to control the production of the facial expressions. People regularly produce expressions when they wish to communicate to another person how they feel (Zuckerman et al., 1986), and currently I propose this extends to deceptive scenarios. The explanation provided based on the current research is that the differences that may exist between genuine and deceptive expressions are not sufficient for decoders when assessing veracity. The implication of DEC is that (1) people seem able to produce genuine looking expressions on command (Experiment 4-5, stimuli creation), and (2) decoders are not able to discriminate these expressions as genuine or deceptive (Experiment 4-5, decoder performance).

Research has shown that voluntary facial control develops with age and training (Ekman, Roper, et al., 1980), but has argued that some aspects of facial expressions seem to be harder or impossible to control (Gosselin et al., 2010). Displaying deceptive expressions can be seen as an effective and deliberate communication tools having many social benefits, ranging from outright deceptive to general social compliance (Ekman & Rosenberg, 2005).

They can be used to hide negative affect, prevent conflict, escalation of a situation, spare feelings, reassure, and gain someone's trust (e.g., Hecht & LaFrance, 1998; Provine, 1997). More severely, deceptive displays can also be used for manipulation, deceiving (Keating & Heltman, 1994), or masking one's true emotions or intentions (e.g., smiling when actually angry; Ekman & Rosenberg, 2005). Thus, the ability to discern genuine from deceptive emotional expressions is of high value for individuals.

Spontaneous expressions rarely occur in a bubble; they are influenced by social factors, as well as attempts at regulations, masking, and strategic use. Therefore, differences between deceptive and genuine expressions might not be as vast (Scherer & Bänziger, 2010). In Experiments 4-5, I attempted to isolate both genuine and deceptive expressions from external (social and motivational) factors as much as possible, by eliciting them in a controlled environment. This allowed for a clearer comparison between these types of expressions, at the cost of some ecological validity. The results of the accuracy scores of decoders can be seen as decoding performance in a clean setting, as they were free to examine the expression in the absence of distracting information, such as speech or other contextual elements. While it can be argued that context can aid classification (Blair et al., 2010; Bond et al., 2013), this is only relevant for mismatched situations (as has been used in most emotion recognition research). The current counter-argument being that when lying the deceptive expression is produced to match the scenario in which it occurs (i.e. the liar wishes to portray an emotional state that matches what an honest person would display in that particular situation). Therefore, context would not serve as a diagnostic tool for authenticity discrimination, but one to further hinder performance. However, this is purely speculative at this stage, and requires empirical confirmation.

DEC is a relevant contribution to our understanding of why the emotion-based approach to detecting deception does not result in significant improvements in accuracy, even if decoders are able to recognise the emotional cues displayed by liars. The current research explains that beyond the lack of veracity classification using leaked emotional cues as they are rare (see ten Brinke & Porter, 2012) the misclassification of deceptive emotional cues as genuine further impacts deception detection accuracy. This is especially clear as emotion recognition (empathy and facial cue recognition) were unrelated to accuracy over multiple stimuli sets, each with different levels of stakes and type of lie (e.g., Experiment 2, 3, and 8); suggesting the effects reported are not a result of a specific stimulus set.

While it can be argued that the results of the experiments in Chapter 6 do not produce irrefutable proof that decoders are incapable of distinguishing emotional cues based on authenticity, it should be noted that decoders in those experiments had the specific task of decoding veracity, which may not occur in a natural setting when simply viewing statements. As seen in the past research on veracity judgements, people rarely assume the information they receive is deceptive, unless prompted to consider that to be the case (DePaulo & DePaulo, 1989). It is not implausible to assume that the results presented in Chapter 6 for the two surprise expressions experiments offer the 'best case scenario' of decoders' ability to classify expressions based on veracity. This may also explain why the HSE lies in Experiment 3 were easier to classify, as the videos contained only emotions that senders were using to mask their underlying disgust. In a true deception scenarios the emotions displayed, both genuine and deceptive (as defined in Chapter 5), will vary, and due to the inability of decoders to separate them based on authenticity will result in no accuracy increase or even a decrease. This supposition would be the next step in developing the DEC as it relates to detecting deception.

In support of this suggestion, ten Brinke and Porter (2012), found that in real-world high-stakes lies, liars do attempt to produce deceptive expressions, but are not always successful in the resulting display. However, they also reported that decoders when viewing the videos were unable to differentiate between the deceptive and genuine expressions above chance level performance, supporting the claims made by the DEC (see also Krumhuber, et al., 2014). Similarly, Porter, ten Brinke, and Wallace (2012) found authenticity discrimination was not influenced by the intensity of the emotion or the presence of more leaked expressions, suggesting the quantity of cues and their ambiguity is not a full explanation for the low detectability claimed by the emotion-based approach. These findings cast doubt that in a real-world setting where people are not instructed to classify the authenticity of emotional displays and where emotions tend to be less prototypical or more ambiguous observers could distinguish genuine from deceptive emotional signals.

The DEC hypothesis is also compatible with the current understanding of embodied emotion simulation accounts. These accounts, such as the Simulation of Smile Model (SIMS; Niedenthal, Mermillod, Maringer, & Hess, 2010), suggest that emotions are distinguished (by valence and authenticity) through embodied simulations. That is, the perception of an expressions automatically triggers the same facial configuration in the observer (i.e. mimicry; Hess & Fischer, 2013), which induces in them the same emotion (i.e. emotional contagion; Hatfield et al., 1994; Hess & Fischer, 2013; Keysers & Gazzola, 2009). The SIMS model posits that due to the differences in meaning behind genuine (positive) smiles and deceptive (polite) smiles the observer simulating the emotion should experience different emotional contagion activation (i.e. positive or negative physiological activation). However, this is only a valid hypothesis if there are differences between genuine and deceptive expressions. While most research on embodied simulations has found such effects, they utilised Duchenne and Non-Duchenne smiles (i.e. pre-selected to match facial muscle activation criteria; e.g., Maringer et al., 2011). However, this distinction in activation based on authenticity has been challenged (Krumhuber & Manstead, 2009), suggesting that differences in simulation are less likely to occur. Therefore, decoders are bad at detecting the authenticity of emotions due to liars being able to produce re-enacted emotions that are "good enough" to activate the embodied simulation in the target that corresponds to the emotion they portray, which the decoder will infer to be true.

**Improving the Classification of Emotional Cues**

In Chapter 5 I presented a new classification of emotional cues, which I believe can further aid deception research as well as emotion recognition research. This classification separated emotional cues into *genuine cues* and *deceptive cues*. Genuine cues were further sub-divided into *leaked cues* and *truthful cues*. For deceptive cues I further sub-divide these into *fabricated cues* and *removed cues*. In light of the current research and re-interpretation of the literature I will provide definitions of these categories again to aid comprehension and illustrate their importance for future research. Genuine cues are emotional information displayed that reflect the true underlying affect of the sender. Leaked cues are brief displays of genuine affect that a sender is unable to conceal. Truthful cues are spontaneous, unrestrained displays of affect that co-occur with truthful discourse or interaction. Deceptive cues are emotional cues produced voluntarily with the aim of misleading the receiver of the message. Fabricated cues reflect emotional information that the deceiver wishes to display for the benefit of their lies, while removed cues are attempts to neutralise one's emotional displays, to hide their true feelings.

Thus far researchers have focused on how decoders use leaked cues without considering the effects that other categories of emotional cues can have on the veracity judgements. Considering the DEC hypothesis, it would suggest that while leaked cues (if present) could potentially aid detection (e.g., HSE videos in Experiment 3), the presence of deceptive cues can hinder accuracy (see Zloteanu, 2015). I am proposing that the ability to recognise emotional cues is limited to recognising that a specific cue represent a specific emotion (e.g., a smile means the sender is happy), and does not extend to further processing of the information into authentic or deceptive (see Experiment 2, 3, 4, and 5).

**Deceptive Emotional Cues: Not a Costly Behaviour**

It is claimed that adaptive signals only emerge if they benefit the sender (Krebs & Dawkins, 1984). Additionally, it has been suggested that producing deceptive signals of emotion are costly to the sender, especially if it does not communicate the correct information (Ekman, Roper, et al., 1980; Owren & Bachorowski, 2001, 2003) and therefore are bound to be rare in real-world scenarios. This has been claimed in research on nonverbal behaviour such as crying (Hasson, 2009; Hauser, 1997; but see Haig, 2014) or blushing

(Dijk, Koenig, Ketelaar, & de Jong, 2011). However, emerging research on faking the pain expression, has shown that it is very difficult even for professionals to distinguish genuine from fake pain (Hill & Craig, 2004). In that specific scenario, a patient judges the costliness of producing a genuine-looking pain response as an acceptable cost for them to potentially receive the outcome they desire (e.g., an addict getting a prescription painkiller). It is not difficult to extend this logic to other deceptive scenarios, such as those of serious high-stakes lies, where producing a deceptive expression might help escape suspicion. If a liar displays a deceptive expressions, it is important that they are believed, otherwise there is no purpose of producing such a display. Research has shown that failed attempts at appearing sincere can result in reduced cooperation from interaction partners (Johnston et al., 2010), and reduced ratings of trustworthiness (Ekman & Friesen, 1982).

I propose that the data from Chapter 6 demonstrates that the argument of producing deceptive cues being 'costly' is not supported. As seen from Experiments 4 and 5, senders do not show great difficulty in controlling their facial muscles in such a way as to both improvise and reproduce an affective display on command, with significant success. This data, while not definitive, suggests that senders have the appropriate mechanisms to display emotional cues when the tasks demands it (see also Krumhuber & Manstead, 2009). This implies that producing deceptive expressions is a rather mundane task.

The argument that senders rarely produce fabricated signals is grounded in the perspective that senders 'encode' emotional information which is subsequently 'decoded' by receivers, referred to as the 'representational approach' (see Bachorowski & Owren, 2003). The implication being that receivers have adapted to perceiving and decoding the meaning behind these signals due to it providing a survival benefit.

However, an alternative perspective may better reflect the findings in the literature and the data reported here: the affect-induction approach (Owren, Rendall, & Bachorowski, 2003). It states that the primary function of emotional information is to influence the emotional state of the receiver. That is, senders produce emotional cues for the purpose of signalling the respective affective states to receivers. The affect-induction approach argues that emotional displays are meant to influence the receiver, and are generated with that purpose in mind (i.e. a laugh is audible so that the listener can clearly infer the affective state of the sender). This perspective also aids in understanding the apparent universal signals of emotions, as senders would attempt to produce distinct but recognisable signals to ensure that the induced response in the listener is stable across various situations, as well as explain in-group advantages (Elfenbein et al., 2007).

If decoders did not benefit from perceiving such signals, over time they would be ignored (Searcy & Nowicki, 2005; Zahavi & Zahavi, 1999). The representational perspective argues the receiver perceives and decodes the meaning behind a specific signal that is involuntarily produced by others to infer their emotional state and predict upcoming behaviour. The affect-induction approach, by contrast, assumes the process evolved primarily to send emotional information to listeners that would influence their affect and behaviour.

Extending this approach to deception would suggest that deceptive emotional cues should not be viewed as 'rare' or 'costly' in production, as they clearly serve a specific purpose: inducing a specific affective state (belief) in the decoder of the signal, which benefits the sender. Reinterpreting the available data using this approach can explain why human decoders have difficulty discriminating the authenticity of emotional cues (Experiment 4-5), but are skilful at recognising and categorising various emotional expressions (Experiment 2 and 7).

This interpretation is not without limitations, as there are clear examples of behaviour that can be used to infer the emotional states of others which the sender may wish to suppress but are unable to do so, such as blushing (Crozier, 2010). More importantly, this approach does not explain the existence of leaked emotional cues. The affect-induction approach might argue that the role of all emotional information is to clearly represent the affective state of the sender, and emotional control or deceptive behaviour developed afterwards. However, it is difficult to speculate within the current data. Overall, research must make the distinction between affective neurophysiological states and affective signalling behaviour to fully understand emotions and their recognition in communication.

**Emotion Recognition and Deception Detection**

The accurate recognition of other's emotions is important for effective communication (Hall et al., 2009). The prevalent view regarding emotion recognition and deception detection is one of a beneficial relationship. Decoders that are better at perceiving and interpreting emotional information should be able to identify truthful emotions and leakage in liars. But this relationship can be more complex for situations where genuine emotional cue are scarce or absent.

Throughout this thesis I have attempted to demonstrate that the linear, positive relationship between emotion recognition and deception detection performance is not supported by the data. In the previous section I argued that this is partly the case due to liars being able to produce emotional displays that bear the hallmarks of genuine expressions, making the separation of such cues difficult. The end results being that authenticity discrimination using the emotion-based approach being quite low (e.g., Krumhuber & Manstead, 2009; Porter et al., 2012). In the next section I will discuss the second component of this relationship: how emotion recognition influences the veracity judgment made by human decoders. Specifically, I will interpret the current data to reflect the method with which human decoders integrate and process emotional information when attempting to detect deception in others.

**Individual Differences in Emotion Recognition and Accuracy**

In the deception detection literature individual differences have generally not been found to impact accuracy (Aamodt & Custer, 2006). However, throughout the current thesis it has been shown that individual differences in empathy seem to impact the accuracy of detecting deceptive statements made by others (Experiment 2, 7, and 8). Empathy also has a strong relationships with facial expression recognition (Besel & Yuille, 2010; Gery et al., 2009; Marsh & Blair, 2008). Research tends to define empathy as the ability to accurately infer the affective state of another (Banissy et al., 2012), however, the data presented suggests empathy hinders the recognition of deceptive communication. Specifically, I suggest that empathy interferes with the judgement process by placing greater ‘weight’ on emotion-related information, and potentially treating deceptive emotional cues as genuine.

Caution needs to be taken as the studies presented here looked at empathy in a correlational manner, due to the difficulty of experimentally manipulating empathic accuracy in decoders, and thus the results should be taken as such. However, the few studies that have considered emotional sensitivity or emotion recognition and deception detection can be used to support the findings reported here. For example, oxytocin (the purported empathy enhancing hormone) results in a decrement in detecting deception (Israel et al., 2014), while the perception component of emotional intelligence (EI) has a negative relationship with accuracy (Baker et al., 2013). As the study by Baker and colleagues used videos of real-world, high-stakes emotional lies, as portrayed by actual deceivers, it supports the results of Experiment 2 and 8 generalizing to other scenarios. Similarly, DesJardins and Hodges (2015) investigated deception detection and empathic accuracy[5], finding that decoders were more accurate at inferring the thoughts of their conversation partners when these were honest, but not when being deceptive. Their findings could be interpreted as showing support for the claims currently made in this thesis that empathy is useful for correctly inferring the affective states of other only when the cues perceived are genuine. For example, Wojciechowski et al. (2014) reported that EI was positively correlated with face decoding and identifying mismatches in expressions, demonstrating indirect support that emotion recognition improves the detection of leaked emotional cues.

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[5] While the DesJardins and Hodges claim they were measuring empathic accuracy, their study simply compared the ability of interactive partners to match their perception of a scenario with the intention of their partner, but did not provide an explicit measure of empathy. Therefore, the term “empathy” should be interpreted with caution from their data.

Overall, it suggests that research investigating emotion recognition and deception must ensure that they separate classification accuracy with authenticity discrimination.

In veracity judgements, my research suggests that for individuals considering the emotional information provided by another as being deceptive is antithetic to the role of empathy. Being highly empathic can be seen as placing more importance on the apparent emotional state of another, instead of on the authenticity of the message. This is because, in non-deceptive interaction, being suspicious and doubtful of another can have a negative impact on their interaction and relationship (see McCornack & Levine, 1990a). This explanation would suggest that emotional information has a different role for decoders when they are being deceived than it has in genuine interactions. Here, being more perceptive and receptive to another's affective states can be detrimental, as the desire of empaths to engage in a successful social exchange overwrites the analytical nature of judging veracity.

While the data presented is insufficient to reach a definitive conclusion as to the exact mechanism through which empathy operates, one explanation is proposed. The effect of empathy on veracity judgements can be seen as a predisposition of decoders to regard communication as reflecting the accurate underlying disposition of the sender. That is, the emotions a sender displays are perceived as representing their true underlying affect. This interpretation separates the effect from the typical truth-bias, which occurs in the absence of veracity information. This is supported by the data, as empathy and response bias did not correlate in any of the experiments presented (Experiments 2, 4, 5, and 7).

***Empathy and Veracity Judgements.*** The current data on empathy and its relationship with deception detection provides evidence for the need to still consider the effect of individual differences in decoders on veracity judgements, in spite of past research indicating to the contrary (Aamodt & Custer, 2006; Levine, 2016).

Presently, apart from the effect of empathy no other measure of interpersonal or nonverbal sensitivity has demonstrated a significant relationship. In the current data, theory of mind, microexpression recognition, subtle expression recognition, and sensitivity to nonverbal cues were not found to have any relationships with deception detection. However, empathy was found to interact with accuracy on multiple occasions in the current data (Experiment 2, 3, 7, and 8).

In light of the empathy finding of this thesis, this research supports my interpretations that individuals that rely less on believing the information presented is an accurate representation of the internal affect of the sender achieve higher accuracy.

In situations of low suspiciousness, accurate information processing is ignored in favour of the more heuristic interpretation of cues as signs of honesty, potentially suggesting the existence of an *empathy bias*. This empathy bias can be viewed as lowering the detection threshold for classifying emotional cues. That is, it requires less time and information for an empathic decoder to classify a behaviour as reflecting a specific emotion. In a non-deception related scenario this may result in more successful interactions as empathic decoders are 'quicker to react' to the emotional state of others (e.g., Jani, Blane, & Mercer, 2012). However, in a veracity judgement scenario, empathy may impede accuracy as decoders are quicker to judge (and less critical) of emotional information resulting in misinterpreting deceptive cues as genuine (e.g., that a posed smile reflects real happiness). This post-hoc explanation requires empirical validation, but is made based on the data presented in this thesis. Specifically, the negative correlation between Empathy and Accuracy of Experiment 2-3, and the lower Accuracy (A') score of High Empaths in the Closed posture in Experiment 7-8. While in Experiment 7-8, the Open posture High Empaths obtained the highest accuracy scores, this does not contradict the above suggestions, as the higher scores are argued to reflect the difference (improvement) in information processing of the information available (although only marginally), which in Experiment 8 was shown to reflect a reduction in usage of nonverbal information.

Future research should uncover the extent to which individual differences in emotion recognition and related constructs interact/interfere with the veracity judgement process.

**Emotion Recognition: Classification Accuracy or Authenticity Discrimination**

Specific traits and intentions can be accurately inferred from briefly viewing the face of a stranger, such as personality traits (Little & Perrett, 2007), sexual interest (Boothroyd, Cross, Gray, Coombes, & Gregson-Curtis, 2011), or even likelihood of being a sexual offender (Porter, ten Brinke, Shaw, & Strugnell, 2011 in Porter, Korva, & Baker, 2011).

'Emotion recognition' has been used as an umbrella term for many (arguably, different) phenomena in interpersonal sensitivity. An important distinction with regards to future investigations of the emotion-based approach has been proposed in this thesis: separating emotion recognition accuracy into (1) detecting that a specific display reflects a specific emotion (i.e. classification accuracy) and (2) determining if an emotion reflects the true affect of the sender (i.e. authenticity discrimination). This distinction is relevant to explaining past inconsistencies in the deception literature, such as finding no improvements (Hill & Craig, 2004), slight improvements (e.g., Porter, Juodis, ten Brinke, Klein, & Wilson, 2010), positive correlations (Warren et al., 2009), or negative correlations (Experiment 2-3). Aggregating these two abilities can obscure relevant effects (e.g., finding that emotion intensity of lies does not aid detectability for decoders; Porter, et al., 2012) and produce incorrect conclusions that are not representative of true veracity judgements (e.g., facial cue training improving recognition of emotions but does not translate to veracity judgements; Matsumoto & Hwang, 2011; Experiment 3).

Presently, I have demonstrated that the ability to detect microexpressions and subtle expressions does not relate to deception detection accuracy (Experiment 2, 3, 7). Furthermore, while accuracy in detecting facial cues is moderately high, people are not as accurate at determining if such cues are spontaneously produced or voluntarily fabricated (Experiment 4-5). These two findings are used to justify my recommendation that future emotion-based deception research, especially training interventions, to make the distinction between recognition and authenticity discriminability, to fully understand the effect that emotional information has on the decoding process.

**Emotion Recognition and Veracity Judgements**

It is abundantly clear that emotions play a significant role in decoding deception. However, this relationship is not as linear as once assumed by past theoretical accounts (i.e. that the better a decoder is at perceiving emotional cues the better they should be at detecting deception). The current research provides a different relationships. It seem that the more adept an individual is at reading the affective states of another, the less accurate they are, especially when decoding deceptive statements (Experiment 2). Furthermore, increasing the stakes to the liar does not result in improved detection even when trained to recognise emotional cues (Experiment 3), however, the presence of supressed or leaked emotional cue does improve accuracy (HSE compared to HSU, in Experiment 3).

The proposition for explaining this effect is that humans have the predisposition to presume all emotional cues are genuine, and reflect the true underlying affect of the sender, unless prompted to the contrary. This explanation is supported indirectly by the results of Experiment 4 and 5, as there decoders were highly accurate in detecting instances of genuine affect (as high as 63%), but showed much lower performance for deceptive emotions (as low as 39%), as well as the results of the HSE videos which were classified more accurately (due to the assumed presence of leaked cues) compared to the HSU videos which contained fabricated emotions only (Experiment 3).

Borrowing from the emotion simulation accounts, it is argued that emotion knowledge is not amodal, and will intrinsically be influenced by the activation of physiological reactions (e.g., facial mimicry). This implies that emotion recognition does not occur based on knowledge alone. For the current interpretation, it is argued that decoder perceive the emotional display of the sender, which automatically activates the emotion (mimicry), and influences perception of the affective state (emotional contagion). However, while this can aid classification for genuine affect, it is detrimental for deceptive emotions, as these *look* like their genuine counterparts, but are produced by the sender to create a false perspective in the decoder. Furthermore, the simulation accounts argue that such embodied states can occur for anything, not just genuine emotions. However, as mentioned in Chapter 2, learning of “deceptive cues” is difficult, as people rarely catch the liar in the act, or receive feedback after an interaction. Due to this fact, an accurate classification criteria for simulation may never develop. Therefore, the decoder may process an emotional display using a “best guess” approach, where they match the little information they have with a pre-existing simulator, resulting in the deceptive (i.e. incorrect) inference. While this conclusion is currently speculative, it is consistent with current and past research, and would have great value to be empirically validated in the future.

In addition to this general effect of emotion recognition, the empathy bias proposed further impacts this phenomenon (Experiment 2-3). Empathy is directly linked to differences in facial mimicry and emotional contagion, however, it does not improve classification accuracy, but does reduce reaction time to judging emotional stimuli (Blairy, Herrera, & Hess, 1999; Kosonogov et al., 2015; Petrides & Furnham, 2003; Stel & van Knippenberg, 2008). Empathy may act to increase the speed with which mimicry occurs in decoders, which in deceptive scenarios means faster incorrect classification of cues. Indeed, research finds that individuals showing stronger automatic facial mimicry tend to have high levels of empathy (Sonnby–Borgström, 2002). Additionally, emotion contagion negatively relates to authenticity discrimination, as more susceptible individuals are more likely to interpret all emotional displays as genuine (Manera, Grandi, & Colle, 2013).

Neurophysiological research proposes emotion recognition occurs via two routes: a slow route involving the matching of visual input with stored knowledge of emotions, and a fast route involving automatic emotion simulation serving as a proprioceptive cue (Danckert & Goodale, 2000; Whalen et al., 1998). Empathy is argued to facilitates the speed of emotion recognition via the fast route (as it influences the automatic process of emotional contagion), resulting in less processing before a judgment is made (Stel & Vonk, 2009). This can also be used to explain the negative correlation between empathy and accuracy in Experiment 2, as low empathy decoders are less likely to mimic the emotional displays of others, forcing any recognition of such displays to rely on visually matching the display to conceptual knowledge of the emotion and not through embodied simulations.

The research presented currently suggests that emotion recognition sensitivity, especially empathy, is detrimental to veracity judgements as it can only enhance the detection of genuine cues (which have been found to occur rarely; Porter et al., 2012), but hinder the detection of deceptive cues.

**Authenticity Discrimination: Can Decoders use Emotional Cues to Determine Veracity**

The proposition of the DEC hypothesis is meant to explain how we should view emotional information in the context of deception. Senders should not be seen in deceptive scenarios as ‘leaky liars’, where an astute decoder can use the available cues to make a rational veracity judgement, but as liars also using emotions strategically to aid their deception. While simulated emotions have been considered in the past (e.g., Soppe, 1988), they have not been properly addressed in the context of both a veritable strategy that liars could use, and as a source of difficulty for decoding veracity.

Research on the production of simulated emotions has been quite scare in the deception literature. A series of experiments by ten Brinke and colleagues (ten Brinke et al., 2012) coded behavioural differences of real-world liars and truth-tellers, finding that, liars displayed more expressions of surprise, which they attributed to a failed attempt at appearing sad. This would supports my claim that liars attempt to use emotions to aid their lies, however, that they are not always successful in this attempt. The question remains if decoders could detect these failed performances, and ascertain the true veracity of the sender. Unlike Experiment 4 and 5 of this thesis, they did not assess how decoders perceived these expressions in a dynamic decoding setting (i.e. judging the veracity of the pleader while watching the videos). However, support for my findings are found in two later studies by the same team, utilising the same stimuli, reporting that decoders were unable to distinguish the veracity of the statements or authenticity of the emotions beyond chance performance

(Porter, Juodis, et al., 2010; Porter & ten Brinke, 2008; Porter et al., 2012). Similar results have been reported in the emotion literature as well (see Calvo, Gutiérrez-García, Avero, & Lundqvist, 2013; Krumhuber & Manstead, 2009; Okubo, Kobayashi, & Ishikawa, 2012). Again, it seems that the singular instance where research finds authenticity discriminability occurs is when looking specifically at posed happiness expressions (Ambadar, Cohn, & Reed, 2009; Johnston et al., 2010; McLellan, Johnston, Dalrymple-Alford, & Porter, 2010).

However, decoders seem to perform better when viewing liars that are attempting to supress their emotions. This was partially found in Experiment 3 for the HSE accuracy compared to the HSU videos, replicating past results (Ekman et al., 1988; Warren et al., 2009). These findings are in line with the suggestions made by this thesis that decoders *can* use emotional information to ascertain veracity, but *only* if said information is genuine (i.e. reflects the true underlying affect of the sender). As it stands quite little is known about the mechanism(s) people use to determine if an emotion is genuine or fabricated (e.g., Krumhuber, Likowski, & Weyers, 2014). The aim of the arguments presented in this thesis is to being the development of research explaining this process in deception and its detection.

**Garbage In, Garbage Out: Information Processing more Important that Cue Perception**

The existing literature suggest that human decoders are not attuned to the nonverbal information present in deception (Bond & DePaulo, 2006, 2008). In Experiment 1, 2, 3 and 7 consistently individuals seemed unable to uncover specific information that can be used to detect deception. Decoders cannot pool their knowledge to improve detection (Experiment 1), emotionally perceptive decoders do not perform any better (Experiment 2), and even providing training of relevant cues fails to improve accuracy (Experiment 3). In addition to this, the less decoders focus on using cue-based detection the more accurate they seem to be (Experiment 2, 3, and 8; see also Bond, et al., 2013). Overall, the present data indicates that relying on nonverbal cues does not aid deception detection.

I argue that these findings have a common source which contradict the "non-sensitive decoder" perspective: (1) decoders perceive, but process nonverbal information incorrectly, and (2) improving information processing improves veracity judgements.

In Experiment 1 (Pairs vs. Singles) the condition in which decoders had to use a specific set of reasons for their judgements resulted in the highest accuracy and lowest bias (Reason condition); this was argued to reflect the fact that decoders in pairs rely less on hunches and intuition, while also not being able to use their own stereotypical beliefs about cues. The increased accuracy could be attributed to the reduction in truth-bias, however, this itself can reflect a positive improvement in the judgement process. In Experiment 2 the decoders that had the lowest empathy scores where better at detecting deceptive statements. This finding was explained as their reduced reliance on emotional or nonverbal information in the videos, which tends to be non-diagnostic, in favour of contextual or verbal information (Vrij, 2008). It can be argued that low empaths were more analytic towards the information presented and relied less on heuristic decision-making. This reflects the findings in Experiment 3, where decoders in the bogus training condition showed a trend of higher accuracy than both the control and ERT condition. While the bogus condition provided no useful information, it can be argued that it focused the attention of decoders, improving the way information was processed (Levine et al., 2005).

More direct evidence is seen in Experiment 7-8, where decoders adopting the Open posture demonstrated improved deception detection accuracy. In Experiment 7 this was suggested to reflect an improvement of decoders in perceiving or utilising behavioural information from senders, as the open posture represents an embodied state of openness to communication (Mehrabian & Friar, 1969). Experiment 8 measured decoding performance of the Open and Closed postures on both Low and High-stakes lies (attempting to uncover if increasing behavioural cues aided detection), as well as measuring decoders' gaze and attention (attempting to uncover differences in attention to nonverbal behaviour). The results of this study revealed that the Open posture decoders tended to look for shorter periods at senders (reduced overall gazing time, as well as reduced looking at the hands), while not less frequently overall (as both conditions fixated the same number of times at senders), while stakes aided detection accuracy slightly. The higher accuracy for the Open posture coupled with the reduced looking time suggests that either the decoders processed information faster or were relying on other sources to make their veracity judgements.

Tentatively, these results seems to indicate that accuracy can be increased if decoders' ability to process the information available to them is manipulated, such that they ignore irrelevant information and focus on non-behavioural information (Low Empaths in Experiment 2, BT condition in Experiment 3) and their intuition/hunches (Reason condition in Experiment 1, and Open posture in Experiment 8). Currently, it is uncertain what cues or a specific cue may be used by decoders when making veracity decisions, especially since they rarely have insight into their own decision-making process (Vrij, Granhag, & Mann, 2010; however, see Hartwig & Bond, 2011).

The argument I propose is that emotions are a part of this process, and can interfere with the accurate perception of senders (e.g., Experiment 2-3). Emotional cues are more salient to decoders than are contextual cues, and are given more attention and/or weight in the decision-making process (Platzer & Bröder, 2012). For example, research on decision-making has found that if individuals are presented with an irrelevant cue while making a decision, presenting that cue at a later date will result in an identical decision being made, even if a more diagnostic cue is available (Nett, Bröder, & Frings, 2015). Furthermore, from the deception literature, Bond and colleagues (Bond et al., 2013) found that providing decoders with a single cue that was 100% diagnostic of veracity (i.e. incentive to lie) resulted in near perfect accuracy (97%). However, when also providing nonverbal behaviour information the accuracy of decoders decreased significantly (76%), as decoders attended to and incorporated meaningless or misleading information into their decision-making process.

Applied to emotional information, people attend to, assign more weight, and give preferential processing to facial expressions (Carrera-Levillain & Fernandez-Dols, 1994;

Fernández-Dols et al., 1991; Mehrabian & Ferris, 1967). If they are unable to separate deceptive from genuine cues (Experiment 4-5), then the decisions they make in the presence of genuine cues will be reproduced in the presence of their deceptive counterparts (i.e. when a liar voluntarily displays an emotion it will be interpreted as if displayed genuinely due to the previous association of the cue with the specific veracity). If decoders prefer this type of information over more diagnostic sources it explains why emotions play such a crucial role in veracity judgements.

The improved information processing argument may simply reflect a change in decoders from being attentive to multiple sources superficially to being focused on a single source, resulting in improved accuracy. Unfortunately, in this thesis the weight assigned to emotional cue and attention was not directly measured, and would be a worthwhile avenue for future research.

Thus, improving accuracy in deception detection may relate to focusing on methods of improving the way decoders process the available information, while attempting to decrease their reliance on non-diagnostic or misleading information. Using a Brunswikian lens model (Brunswik, 1955) in future research, to understand if multiple cues or a single predictor cue is driving deception detection performance, or if indeed if reflects a level of cue processing (i.e. superficial versus thorough) is warranted (see also, Gigerenzer, 2008).

**External Factors in Decoder Veracity Judgements**

A final contribution of the current thesis is the research regarding new avenues in deception detection. Specifically the role of situational factors on veracity judgements and suspect perception, and the utility of the passive lie detection approach.

In Experiment 6, I demonstrated that factors external to deception decoding process can have significant influence on how suspects are perceived and on the accuracy of subsequent veracity judgements. Using a simple handcuffing manipulation, it was shown that limiting the ability of senders to gesticulate freely impacted not only objective differences between liars and truth-tellers, but also the way they were perceived. Specifically, all handcuffed suspects had shorter statements and a lower speech rate, while honest handcuffed suspects showed a trend towards moving less overall. The decoder in an active setting (namely, the interrogator) was less able to detect honest statements made by handcuffed suspects, laypersons showed a more pronounced truth-bias towards handcuffed suspects, decreasing their accuracy to detect lies, and police officers, encouragingly, did not show the same bias, but performed overall more poorly on the decoding task.

The handcuffs manipulation is meant to demonstrate that deception detection does not happen in a bubble, and that research investigating veracity judgements should attempt to expand the range of factors they consider, both within the lab and in the real world. Handcuffing is a common approach to handling suspects, and the addition of this element can influence how the decoding process unfolds; specifically in ways that can be detrimental to the wellbeing of innocent individuals. The findings of Experiment 6 alongside research on differences in interrogation practices (Vrij, Mann, & Fisher, 2006b) and differences in senders (Levine, 2016) should be used as evidence for the need to expand the factors investigated in deception research. Importantly, the findings demonstrate that such a simple manipulation influences not only the sender's ability to present themselves accurately, but also subsequent veracity judgements.

The fact that behaviour has an impact on the decoding process has been abundantly clear throughout this thesis, and while it seems to not be a tool to aid (i.e. improve) detection for decoders, it is a clear source for their veracity judgements. The effect of perception was explained as both being influenced by the (small, but consistent) differences that handcuffs had physically on senders and on the salient criminality feature of the handcuffs is attributed to the sender (McArthur, 1980). However, contrary to the prediction, lay observers were actually more reluctant to assume handcuffed suspects were being deceptive (demonstrating a more pronounced truth-bias). Currently, it is difficult to speculate as to why this effect occurred (potentially, decoders were more sympathetic towards watching students in handcuffs take part in an experiment), however, the impact of the findings should not be ignored. Additionally, future research is needed to separate fully the effects of mere presence of a cue to criminality to that of mobility restriction.

While the majority of the thesis has produced data indicative of poor detection performance in human decoders, reflecting the findings of several highly cited meta-analyses (Aamodt & Custer, 2006; Bond & DePaulo, 2006; Hartwig & Bond, 2014). The final experimental chapter of the thesis outlined a potential avenues for future research into improving accuracy: passive lie detection (Chapter 8). Experiment 7 and 8 demonstrated a novel method to achieve improved deception detection performance utilising a simple embodied manipulation.

The premise was to develop a method to increase the decoding accuracy without the need for significant intervention, maintaining the integrity of the interrogation or decoding process. And to ensure that the manipulation itself is easy to adopt and does not result in additional response biases. For example, American police training manuals regularly emphasise coercive tactics to intimidate and 'break' suspects into confessing (e.g., Inbau et al., 2001). Recently, Cleary and Warner (2016) reported that while the majority of police officers seem to be trained in fairly benign, information-gathering approaches, over half of their sample was trained in coercive techniques. Moreover, those trained in such techniques were more likely to employ them. Therefore, the aim of the passive lie detection approach is to simply aid in the perception and processing of the available information without introducing harmful elements or additional demand characteristics into the decoding process.

Indeed, the data from both experiments demonstrated that simply adopting an Open body posture—related to the embodied concept of openness to communication—resulted in improved discrimination of truthful and deceptive statements which was not attributable to a difference in response bias. Furthermore, in Experiment 8, this effect was expanded to high-stakes lies indicating a similar trend (however, due to technical difficulties, the reduced sample size makes strong inferences difficult to make). The eye-tracking data suggested this improvement in discriminability is attributed to less focus being given to behavioural cues (i.e. reduced attention to hands of senders). Taken with the findings of past research and my previous experiments, the data would suggest that improved processing of information was the explanation for the effect, especially considering that fixation count (i.e. number of times decoders fixated upon specific areas of the video) did not differ.

While further research surely needs to be conducted, as it stands it illustrates that there exist avenues of detecting deception which can achieve significant improvements by considering the underlying abilities of decoders (e.g., unconscious lie detection; ten Brinke et al., 2014). This may reflect that decoders have a stronger ability to decode accuracy than previously believed. While speculative, such a suggestion could result in marked improvements in the way human decoders detect deception without the need for significant interference in how the procedure unfolds.

**Stakes: Differences in the Type of Lie told on Veracity Judgements**

The role that the stakes to the liar have on the deception detection process has been a source of debate for quite some time. For the emotion-based approach this was especially relevant as stakes influence the strength of the emotions felt by liars and truth-tellers. Increased stakes to the liar result in increased arousal and cognitive load, making any behavioural differences from truth-tellers more pronounced (DePaulo et al., 2003; Ekman & Frank, 1993; Levine et al., 2005). However, meta-analyses investigating the effect of stakes on discriminability find no significant differences (Hartwig & Bond, 2014; Hauch et al., 2014). This has been attributed to stakes affecting both liars and truth-tellers, albeit for different reasons, resulting in no net observable difference (Bond & Fahey, 1987).

While as stated above, the literature is divided on the potential benefit of stakes to the decoding process. However, said research has rarely focused solely on emotional cues and differences in their perception and recognition. At present stakes were found to produce significant differences for veracity judgements under various decoding scenarios, however, not always in the predicted direction.

In Chapter 5, Experiment 3 tested the effect of teaching decoders emotion based facial cues before decoding both low-stakes and high-stakes lies. The results demonstrated that emotion recognition training did not aid classification accuracy for either. However, while no differences were found based on training, significant differences emerged with the low-stakes videos being more accurately classified than the high-stakes videos, contrary to the predictions made by the literature.

The fact that low-stakes lies were easier to detect may be attributable to several factors. Perhaps there were simply vast differences between the stimuli sets themselves, resulting in easier classification for the low-stakes lies for unknown reasons. Subsequently, and not mutually exclusive, it may be that contextual information was more relevant to decoding lies and truths in the low-stakes videos, as compared to the high-stakes videos.

With respect to emotional content, high-stakes emotional subset of the videos were easier to classify than were the high-stakes unemotional videos. While the underlying stakes for both sub-sets were identical, what differed was the fact that senders in the HSE were watching an emotion evoking video while lying or telling the truth, therefore their statements contained more genuine emotional cues (truthful and leaked), explaining their easier classification. However, aside from leakage, it could be argued that supressing a response, be it emotional or otherwise, simply results in increased cognitive load, which made it harder for senders to lie (Vrij, 2008). This explanation has yet to be investigated empirically. The suppressed emotions explanation reflects the suggestion of the inhibition hypothesis, that experiencing strong underlying emotions that the sender is unable to conceal results in easier detection. From this experiment, the data suggests that stakes by themselves are not enough to increase detectability, but if the scenario forces liars to mask strong affect it results in more failed attempts to deceive.

In Experiment 8 stakes were once again considered, as the underlying prediction of the posture manipulation was that it aids the decoding and perception of nonverbal behaviour. If stakes do increase behavioural cues (see Porter et al., 2012), then the posture manipulation should improve detection of high-stakes lies that much more. However, while overall high-stakes videos were recognised with higher accuracy than their low-stakes counterpart, posture did not interact with stakes, although a positive trend was seen.

Currently, stakes seem to moderately impact accuracy in detecting deception, demonstrating both a reduction in accuracy (Experiment 3) and a slight improvement (Experiment 8). While difficult to speculate given the data and differences in stimuli used, it seem that stakes play a role in discriminability, which may relate to how decoders process information. However, the source of these differences does not seem to be as simples as that argued by the emotion-based approach.

Considering the cognitive and affective aspects of the way the liar constructs their lie (i.e. supressing or fabricating) may help elucidate this inconsistency in the data. While the low-stakes lies were the same in both Experiments, the high-stakes videos in Experiment 8 involved a mock crime scenario with much higher consequences (i.e. fear of expulsion from the university) than the ones from Experiment 3, containing fabricated or masked emotions (Warren et al., 2009). The stimuli in Experiment 8 are closer to a real-world scenario on which the predictions of the literature are based. The data suggests that stakes may aid deception detection only if the situation in which the lie was told requires that the liars attempt to suppress incongruent emotions to the ones they are portraying. This evidence can be used as further support that decoders can classify veracity using genuine cues (truthful or leaked), as seen in the HSE videos, but fail to detect deception from deceptive cues (fabricated emotions), as seen in the HSU videos. Unfortunately, the videos in Experiment 8 do not allow for such an analysis to be conducted, as they were not coded for this purpose. Therefore it is difficult to speculate as to the reason for the overall greater accuracy.

Two competing explanations emerge from this data. Perhaps in true high-stakes scenarios, as liars are more motivated to be successful in their deception—experiencing increased cognitive load and arousal—they display more leakage cues, while failing to display convincing deceptive cues to sell their lies; this would explain the results of Experiment 8, and are consistent with the inhibition hypothesis, but expands this explanation to consider increases in cognitive load from the suppression of a default (truthful) response. Alternatively, in low-stakes scenarios producing deceptive cues to aid lie telling could be appraised as costly and not necessary by the liar if they are not motivated (Ekman, Freisen, & Ancoli, 1980; Gosselin et al., 2010; Mehu et al., 2012), resulting in better discriminability as liars are more transparent; this is an emotion-based explanation for the data in Experiment 3, and reflects the self-presentational perspective (DePaulo, 1992). Currently, the data cannot separate the two explanations, or argue that they are mutually exclusive. This would be a highly relevant future avenue of research, as the results of Experiment 3's high-stakes and low-stakes accuracy scores are contrasted by the scores of Experiment 8 suggesting a U-shaped relationship between level of stakes to the liar and accuracy.

# Chapter 11: Future Directions in Deception Research

## Building a Better Understanding of Veracity Judgements and Improving Accuracy

In this thesis I have investigated and attempted to address many of the inconsistent findings and claims of past emotion-based deception research. While the data suggests this approach is not beneficial for decoders to ascertain deception, the utility of this approach should be addressed. I will consider future research avenues, expansions on the current work presented, as well as propose how deception detection using decoders can be improved.

## Improving Detection Procedures for Decoders

From the experiments and literature presented in this thesis a few propositions for improving deception procedures using decoders are presented, alongside suggestions for improving accuracy.

One method that results in improved accuracy that emerged from the data is not to train decoders to use specific cues (Experiment 3), or to increase the number of decoders (Experiment 1), but by affecting the way information is processed by decoders (Experiment 7-8). While this finding was not a direct hypothesis that was tested, multiple experimental findings can be adequately interpreted using this perspective. Providing decoders with structure in their decoding process seems to be relevant to reducing their response bias, as was seen in the Reason condition of Experiment 1, while unstructured deliberation is more likely to result in decoders using their hunches, heuristics, and stereotypical beliefs, resulting in poorer performance.

Additionally, the data suggests that emotional cues should not be the focus for decoders, at least given our incomplete understanding of genuine and deceptive cues (i.e. if reliable markers that can be used to separate authenticity exist). Decoders that either intuitively or through training are told to focus on such information tend to perform worse at detecting deception (Experiment 2, 4, and 5). What seems to provide the most benefit is having decoders focus on the task-at-hand (Experiment 3, 7, and 8). The Bogus training condition, and the Open posture manipulation can be argued to reflect an increase in attention and focus directed at understanding the sender and ascertaining the veracity of their statements. Both approaches resulted in improvement in accuracy, which were unrelated to explicit knowledge of emotional or other behavioural cues. This seems to reflect recent unconscious lie detection research (e.g., ten Brinke, Stimson, & Carney, 2014), arguing that decoders can determine veracity, but this skills needs to be elicited through indirect methods, as to not negatively impact the decision-making process with social rules and heuristics.

Finally, it is suggested that making decoders aware of their biases and over-confidence may aid the decoding process. While this was not a current hypothesis, the insight provided by the Interrogator in Experiment 6 regarding probing techniques demonstrates that being aware of the effect of a given factor can influence your own behaviour and the ultimate outcome. Furthermore, Experiment 6 also demonstrated that researchers and professionals must be aware of the impact that artificial situational factors have on the sender and the detection process.

At present the recommendations for improving deception detection using human decoders is to use a structured response format, grounded in empirical research, focusing attention on the task, reducing distractors, and eliminating incorrect beliefs regarding cues. If possible, intervention studies should adopt an approach closer to passive lie detection, attempting to not impede the decoding process or put strain on the sender and decoder.

**How does DEC Expand to Other Emotions?**

The DEC hypothesis proposed in this thesis was developed using the current findings and the findings (often contradictory) of past deception research. However, while support for this hypothesis is seen even in research using multiple emotions (e.g., Porter, et al., 2012), the current experiments investigated a single emotional expression, and thus requires an extension to other emotions.

Surprise was selected due to its neutral (or context specific) valence as an emotion. It is presently unknown if the valence of an emotion would influence not only the ability of senders to control and display expressions on command, but also the ability of the decoder to discriminate the authenticity of the emotions. To properly develop the DEC account it must be researched using other emotional expressions of different valence and arousal (see Barrett, 1998), and extended to more social emotions, such as shame and embarrassment (e.g., Tracy & Matsumoto, 2008), to understand the full range of control individuals have over the production of their facial expressions.

There is evidence that surprise is not the only emotion that is difficult to distinguish based on authenticity (e.g., Krumhuber et al., 2014; Porter et al., 2012). However, one should not make quick inferences based on this data, as even recognition of facial expressions varies highly based on emotion (Ekman et al., 1987; Ekman & Friesen, 1971, 1986). Importantly, DEC needs to be validated cross-culturally, given recent propositions of emotional dialects (Elfenbein et al., 2007), cultural differences in display rules (Ekman & Friesen, 1971), and evidence that recognition rates vary significantly based on culture (Barrett, 2011; Crivelli et al., 2016; Gendron, Roberson, van der Vyver, & Barrett, 2014).

**Deceptive Emotional Control in Real-Life**

The deceptive expressions used in this thesis were generated under strictly controlled circumstances, allowing senders to focus on the specific task. Ideally, the results of these experiments would be replicated under various deception scenarios, such as during unplanned and unsanctioned attempts to deceive or in an active interview setting, to uncover the robustness of the effect, as well as observe any differences that may occur from the added complexity of the task.

Future expansions on this works need to focus on the method that deceptive expressions are generated in real-world interactions. This work must be expanded in two specific ways to better understand the role of emotions in deception. First, production methods must be matched with the methods that deceivers employ in actual deception scenarios, as naturally generated deceptive expressions may be different than those presented in this thesis. Second, differences between tactics employed by successful and unsuccessful deceivers should be investigated, as research has shown that variability in senders is much larger than that of decoders, with some liars performing very poorly while others being highly successful (e.g., transparent liars; Levine, 2010). This may reflect different strategies and production methods of deceptive emotions (e.g., Porter et al., 2009). Importantly, such data will uncover the appearance of natural deceptive expressions, how frequently they are used, as well as the factors that motivate the decision to use them (e.g., Konrad et al., 2013). The methods used presently in Experiment 4 and 5 sets the framework for how such research should be conducted, by initially testing differences in how these expressions are perceived in a controlled environment, and then comparing these hypotheses to real-world strategies.

An interesting avenue to pursue is separating the effect of genuine expressions on liar's performance based on individual differences in empathy and emotion regulation. This relates to the subdivision of empathy into emotional and cognitive abilities (e.g., Maurage et al., 2016). For example, psychopathic offenders, who are generally regarded as lacking affective empathy (Díaz-Galván, Ostrosky-Shejet, & Romero-Rebollar, 2015), are better at deceiving others about being remorseful (Porter et al., 2009), implying that knowledge of an emotion is more important than the affect corresponding to said emotion. The superiority of the External deceptive expressions in Experiment 5 support this view.

Similarly, emotion regulation (Gross, 1998) may assist senders in managing strong underlying affect that needs to be suppressed (potentially, reducing leakage) as well as allowing them to better simulate genuine affect. For example, Porter and colleagues (2012) found that psychopathy was related to less emotional leakage during deception, whereas EI was related to more convincing displays during emotional simulation; additionally, individuals capable of controlling their affect are more convincing and more likely to be successful at deception (Krokoszinski & Daniela Hosser, 2016; Porter et al., 2009).

Finally, while not investigated directly in this thesis is the relationships between empathy and authenticity discrimination ability. This is especially relevant as it would corroborate my claim that empathy results in more misclassification of emotional expressions. As the current studies were exploratory, this hypothesis was not considered, however, research has found that restricting facial mimicry (a component of empathy) can increase accuracy in detecting genuine and deceptive expressions (Stel et al., 2009), suggesting it to be a valid claim and a worthwhile avenue for future research.

**Behavioural Channels of Emotion – Moving Beyond the Face**

This thesis manly focused on facial expressions as emotional cues, based on the reasons addressed previously (e.g., universal nature, cross-cultural recognition, involuntary, spontaneous, and ubiquitous production), however, facial expressions are not the only source of nonverbal cues, nor are they suggested to be the only one that decoders attend to or consider in their veracity judgements. For example, research on verbal cues of emotion suggest that for decoding deception they are a more reliable predictor than other emotional sources (DePaulo et al., 1985; DePaulo, Zuckerman, & Rosenthal, 1980; Zuckerman, DePaulo, et al., 1981).

Beneficial to both expanding the understanding of emotions in veracity judgements and to developing the DEC hypothesis further, researching how senders may manipulate other communication channels for emotions is highly relevant. For example, recent research on fabricated laughter suggests that deceptive emotional control expands to verbal cues as well (McKeown, Sneddon, & Curran, 2015). Similarly, body movement and postures are another source of emotional information which may be easier for deceivers to utilise as these are under greater control that most nonverbal channels. Indeed, research has demonstrated that people attend to and recognise emotional information from the body movements and gestures of other (e.g., Castellano, Villalba, & Camurri, 2007; Meeren, van Heijnsbergen, & de Gelder, 2005; Stathopoulou & Tsihrintzis, 2011). Understanding which channels of communication decoders attend or prefer when making veracity based judgements is relevant to understanding of how veracity judgements are made, and of how to manipulate this process to improve accuracy.

Finally, a limitation of the research in Chapter 6's investigation of deceptive emotional cues is the use of video only for the expressions absent of audio, eliminating any auditory cues. While this is the aim of future research—understanding the effect of auditory cues on authenticity discrimination—for the present research the methodology aimed to control the stimuli to obtain initial evidence for the DEC, as well as respect past methodological approaches (e.g., McKeown et al., 2015). Including auditory information could provide a better understanding of the information decoders use to ascertain authenticity, more closely mirroring real-world decoding.

**Authenticity Discrimination: Investigating Behavioural Difference in Deceptive and Genuine Emotional Cues**

Early research argued that differences should exist between expressions that are fabricated to those that are spontaneously generated (Ekman, 2003b). However, research has found that not all emotions produce distinct activation patterns between posed and genuine expressions (surprise being among them; e.g., Namba, Makihara, Kabir, Miyatani, & Nakao, 2016), and more importantly even the smile expressions, the strongest evidence of this approach, does not show any unique features that are impossible to replicate by deceivers (e.g., Krumhuber & Manstead, 2009).

It can be argued that the lack of reliable differences is reflected in the contradictory findings reported in past research. For example, posed expression of emotions are assumed to be less intense in presentation as they are absent of the underlying experience of the emotion (Hess et al., 1995; see also, Levenson, 2014), or more intense and containing additional features, as they are the attempt of the sender to communicate the deceptive information to an observer successfully (Hess & Kleck, 1990; Naab & Russell, 2007; Namba et al., 2016; Russell, 1994; Tcherkassof, Bollon, Dubois, Pansu, & Adam, 2007). The results of my research support the former explanation, as seen in Chapter 6, were all deceptive expressions were rated as less intense than their genuine counterparts.

This produces an interesting quandary for future emotion recognition research. If there are anatomical and dynamic differences between posed and spontaneous expressions then it calls into question research using prototypical expressions for their stimuli and the conclusions drawn from such research. However, evidence that such markers of authenticity are absent (Namba et al., 2016), unreliable (Krumhuber & Manstead, 2009), and easily replicated (Experiment 4-5), indicate that past research is missing an important component: the authenticity discrimination ability of decoders. The aim of future research should be the attempt to address the mixed findings regarding “reliable” markers for genuine emotional displays by also accounting for this important variable.

This is not to say that there do not exist measurable differences between genuine and deceptive emotional expressions. Other sources may still reflect the difference between voluntarily produced and involuntarily activated emotional displays. Neuroanatomical research has demonstrated the existence of two separate neural pathways related to the production of involuntary and voluntary facial expression production: the extrapyramidal motor system (EMS) and the pyramidal motor system (PMS). The EMS is related to involuntary facial expression production, characterised by reflex-like attributes, resulting in smooth, symmetrical, synchronised, and ballistic displays (Ekman & Friesen, 1982; Rinn, 1984). Conversely, the PMS is activated during the production of voluntary facial expressions of emotion, which is argued to result in differences in how they are produced (Ekman & Friesen, 1982). While activation of the two systems can theoretically co-occur especially in situations of high emotional intensity, they do provide the reason for the behavioural differences between voluntary and involuntary expressions.

The second implication being the impact it has on emotion-based training, both relating to application and interpretability of findings (e.g., Experiment 3). While past research has argued for emotion recognition training, specifically microexpression and subtle expression training (e.g., Hurley, 2012; Matsumoto et al., 2014) can aid deception detection, I believe this is not a valid method of improving accuracy. Such research relies on individuals improving in their ability to detected leaked emotions only, without considering that without authenticity discrimination this skills can results in increased misperception of deceptive emotional cues as reflecting genuine affect. Considering past research through the prism of DEC it should be considered that emotion specific training must ensure it is improving the ability of decoders to perceive emotional cues that are genuine or deceptive.

Currently, investigating behavioural differences between the expressions presented in Experiment 4 and 5 are considered relevant to future research. Understanding what potential cues or information was available in the Improvised and Internal conditions as compared to the Rehearsed and External conditions may provide insight into aspects of their presentation that can be used to discriminate authenticity (Zloteanu, Richardson, & Krumhuber, in prep). Thus far only one such study has found different dynamic properties of spontaneous and posed surprise expressions, but not different facial muscle activation patterns (Namba et al., 2016). They also reported that all expressions activated specific action units (AU) proposed by the universal expressions hypothesis (Ekman et al., 1978).

A final recommendation for such investigations is to consider cultural differences (Elfenbein et al., 2007) and context on perception and recognition (e.g. Bourgeois & Hess, 2008), especially when building a model of cross-cultural and reliable differences between posed and spontaneous expressions of emotions.

**Using Emotions to Facilitate Detection – Coding of Behaviour and Automated Methods**

The data reported here and interpretation offered paint a grim picture for emotions as a source of detecting deception. However, while human decoders may fail at the task of utilising emotional information to improve their veracity judgements such information can still be a valid and useful source to detecting deceit.

The current thesis focused almost exclusively on human detection of deceit, however, recent strides in affective computing (automated and behavioural coding) to detect deception make using emotional cues more relevant. Such methods are also more reliable to employ considering the finding of this thesis that human decoders are unable to separate deceptive from genuine emotional cues. Indeed, a few studies have already attempted such classification procedures, with moderate success, both for automatically classifying spontaneous and posed expressions (Wu & Wang, 2016), and for automatically coding lies and truths using the presence of microexpressions (Su & Levine, 2016). The distinction in terminology for emotional cues provided in this thesis would further benefit attempts to classify veracity based on nonverbal behaviour. Therefore, discounting a potential source of veracity related information is not advised presently, suggesting that a change in approach and improvement in theory driven interactions can result in improved deception detection and understanding of the differences between being honest and being deceptive.

***Implicit Emotion Recognition.*** An aspect of emotion recognition that has not been addressed in this thesis is the difference between implicit and explicit emotion recognition. Beyond the distinction I proposed between classification accuracy and authenticity discrimination, considering the dual nature of emotion recognition may provide further insight into the role of emotions in the decoding process. A limitation of facial emotion recognition studies is the use of explicit labels for participants' responses, usually in a forced-choice response format. This assumes that actual recognition requires an explicit knowledge of the terms for an emotion, which may be not be the case (Walden & Field, 1982). A method of investigating differences in recognition ability is borrowing on recent findings from the unconscious lie detection literature (e.g., ten Brinke et al., 2014). The primary argument for this approach is that individuals have strong(-er) innate abilities to discern veracity, however, social rules or difficulties in articulating a veracity judgement results in poorer accuracy when asked to overtly judge others. The claim is that using more implicit measures, such as asking which sender seemed to be thinking more (a proxy measuring cognitive load; Street & Richardson, 2015), results in improved accuracy.

For emotion recognition, this would be interesting to uncover, as much research has investigated mimicry effects in decoders when viewing facial expressions of others (Blairy et al., 1999). More importantly, there seem to be mimicry differences, at least for smiles, when decoders watch posed compared to spontaneous expressions (Heerey & Crossley, 2013; Krumhuber et al., 2014; Maringer et al., 2011; Oberman, Winkielman, & Ramachandran, 2007; Stel & van Knippenberg, 2008). This could reflect that implicit, automatic responses in decoders relate not only to emotion recognition, but potentially to authenticity discrimination. This was also reflected in the subjective ratings decoders gave the deceptive expression in Experiments 4 and 5, as all were rated less intense, and less genuineness in appearance, however, this did not influence classification accuracy in the current data. Constructing a paradigm in which decoders indirectly attempted to assess the authenticity of an emotion may produce different (better) performance than if asked directly.

**Improvements in Emotion Recognition Research**

Several improvements can be made to how emotions and emotion recognition are researched using the methodology employed in Chapter 6. A limitation of past authenticity identification research is asking the participant if they believe the expression they see is genuine or deceptive directly; utilising a simple dichotomous Deceptive-Authentic response. This approach may not capture the fundamental difference in decoding performance between the expressions. In such a design the classification scores may simply reflect the process of the decoder agreeing that the sender accurately depicted the emotion they were supposed to display, without measuring their ability to discern the veracity of the emotion.

By contrast, the methodology utilised in Experiment 4 and 5 asked participants the question of whether the expression was a result of the event that should induce surprise or if it was in its absence. This allows for decoders to consider the matter that (a) the expression is consistent with the emotion evoking scenario, and (b) it is a response to a real stimulus. This was the rationale behind utilising a response scale that made it clear to the participants that the task involved identifying an expression, based on their level of certainty, that it was produced either spontaneously or voluntarily.

An additional improvement was the use of dynamic stimuli generated using untrained individuals (i.e. not actors) for facial expression recognition and authenticity discrimination. The majority of past emotion based research has utilised static, prototypical, posed facial expressions (see Matsumoto et al., 2008), which rarely occur in daily interactions. Moreover, using actors can result in the expressions being stereotypical caricatures of their genuine counterparts (Conson et al., 2013). Facial expressions are fluid, and their presence in real conversations rarely matches their theoretical prototypical depictions (see ten Brinke, et al., 2012). Furthermore, if there are behavioural differences between facial expression that are deceptive and genuine, using dynamic and realistic stimuli increases the likelihood of identifying them or at least providing a reflection of true decoding ability. One could argue that the methodology used in Chapter 6 is closer to "true" emotion recognition ability, as it not only measures the ability to categorise an expression based on emotional content, but also the ability of the decoder to ascertain the authenticity of the expression. Utilising the current methodology and recommendations would greatly improve our understanding of emotions and authenticity discrimination based on facial expressions.

Initially, it will improve our understanding of how decoders can detect emotional cues that are valid for the detection process (i.e. leaked cues and truthful cues), while adequately considering deceptive cues. For example, in a study investigating decoder ability to detect leakage in deceptive and genuine expressions, Porter et al. (2012) reported that coding the expressions of liars and truth-tellers revealed significant differences in leakage, however, decoders were unable to distinguish authenticity beyond chance level performance. The only emotion that was easier to detect was happiness, supporting my claim that the research on discriminability has too heavily relied on the happiness expression, which does not seem to reflect how other emotions are decoded.

Using dynamic stimuli, such as videos, is a clear improvement for emotion recognition research, especially regarding authenticity discrimination (e.g., Ambadar et al., 2005; Hess & Kleck, 1994; Krumhuber & Kappas, 2005). Dynamic stimuli increase ecological validity (Gross & Levenson, 1995), allow for more subtle elements of an emotion (e.g., onset, timing, duration, fluidity) to be incorporated into the decoding process (Tobin, Favelle, & Palermo, 2016), and can reduce the classification nature of the task itself to more closely resemble a real-world decoding scenario (see Arsalidou, Morris, & Taylor, 2011).

## Conclusion

Deception is an integral aspect of human communication. Unlike other concepts in psychology, deception is unique in that it is ubiquitous in human behaviour, regardless of culture, gender, age, professions, or other factors. Deception requires many components working in synchrony to be achieved successfully. Yet, individuals, even from a young age, are adept at understanding its purpose and utility for their own means. Importantly, while uncovering deception is a clear goal in many scenarios of life, ranging from the mundane to the serious, our ability to detect deception is very poor. The aim of this thesis was to explore the role of emotions in the process of deception detection. The predominant view of this approach is that there are behavioural differences in the emotions experienced and displayed by liars and truth-tellers which decoders can use to detect deception. However, research, including the one presented in this thesis, fails to consistently find this relationship. Utilising the concepts outlined by the emotion-based approach, I attempted to investigate the reason for many of the inconsistencies reported in this field. I strived to understand how emotions are perceived and how they influence decoders' veracity judgment process.

In the first experiment detailed I tackled the issues of poor detection accuracy and increased response biases in multi-decoder deception detection, exploring how decoders make veracity judgements, and how the process of their deliberation influences veracity judgments. The data uncovered that the social aspect of detection can impair judgment and that multiple decoders cannot pool their resources to achieve higher accuracy. The next two experiments focused on why decoders that are more attuned at 'reading' facial expressions do not show the increased deception detection performance proposed by the emotion-based approach. It was argued and demonstrated that focusing on emotional information, either due to innate abilities or training, hinders accuracy, potentially due to an inability to separate genuine and deceptive cues of emotion. Additionally, relating to the function of stakes to the liar, discriminability seems to be influenced predominantly by attempting to suppress strong underlying, incongruent emotions, and not by simply being in a high-stakes scenario.

The following experiments demonstrated that senders can easily produce facial expressions of emotion, which for decoders are difficult to detect as either genuine or deceptive. The explanation provided for this effect relates to emotion simulation models of emotion recognition, where humans rely on automatic, spontaneous activation of embodied knowledge when decoding an emotion in others. In deceptive scenarios this results in misclassification of veracity. The theoretical approaches and conceptualisations I proposed improve our understanding of emotional cues and veracity judgements, especially regarding facial expressions, emotion recognition, and empathy. Overall, it suggests that while humans have a well-defined mechanism for detecting emotions (i.e. classification accuracy), they are poor at detecting the veracity of such cues (i.e. authenticity discrimination).

In the subsequent experimental chapters I outlined a more expansive view of the deception and decoding process. I demonstrated that situational factors imposed on the sender and decoder can impact perception and subsequent veracity judgements. Importantly, it demonstrated that while behavioural cues may not be diagnostic for decoders, they can detrimentally impact accuracy beyond the usual level. Deception theories can be enhanced by recognising the impact of situational factors, which may explain the large variability in the literature. Subsequently, I provided experimental evidence for a new method of improving accuracy, the passive lie detection approach. The findings support the claim that specific postural states can improve the way decoders interpret behavioural cues from senders, improving deception detection performance. While still preliminary, it suggested that focusing on methods of improving information processing is more worthwhile an attempt than having decoders focus on detecting subtle nonverbal cues.

In summary, my thesis provides evidence that emotions, while correctly classified, result in poor accuracy due to the way decoders discriminate them in the context of a deceptive scenarios. Improving the classification of emotional cues, and our understanding of emotion recognition can result in improvements in veracity judgments. Emotions are a useful tool for understanding how individuals make decision in situation of uncertainty, and for improving our understanding of their role in interpersonal interactions. Future work should consider the findings of this thesis related to deceptive emotional control, the influence of individual characteristics relating to emotion and veracity judgements, the difference between classification accuracy and authenticity discrimination in emotion recognition, and building towards incorporating factors relating to the situation in which a lie occurs, the role of more implicit processes, and context.

# References


Aamodt, M. G., & Custer, H. (2006). Who can best catch a liar? *Forensic Examiner*, *15*(1), 6.

Adolphs, R., Gosselin, F., Buchanan, T. W., Tranel, D., Schyns, P., & Damasio, A. R. (2005). A mechanism for impaired fear recognition after amygdala damage. *Nature*, *433*(7021), 68–72.

Akehurst, L., Köhnken, G., Vrij, A., & Bull, R. (1996). Lay persons' and police officers' beliefs regarding deceptive behaviour. *Applied Cognitive Psychology*, *10*(6), 461–471.

Akehurst, L., & Vrij, A. (1999). Creating Suspects in Police Interviews1. *Journal of Applied Social Psychology*, *29*(1), 192–210.

Alač, M., & Hutchins, E. (2004). I see what you are saying: Action as cognition in fMRI brain mapping practice. *Journal of Cognition and Culture*, *4*(3), 629–661.

Alibali, M. W., Bassok, M., Solomon, K. O., Syc, S. E., & Goldin-Meadow, S. (1999). Illuminating mental representations through speech and gesture. *Psychological Science*, *10*(4), 327–333.

Alibali, M. W., Kita, S., & Young, A. J. (2000). Gesture and the process of speech production: We think, therefore we gesture. *Language and Cognitive Processes*, *15*(6), 593–613.

Alpers, G. W., & Gerdes, A. (2007). Here is looking at you: emotional faces predominate in binocular rivalry. *Emotion*, *7*(3), 495.

Ambadar, Z., Cohn, J. F., & Reed, L. I. (2009). All smiles are not created equal: Morphology and timing of smiles perceived as amused, polite, and embarrassed/nervous. *Journal of Nonverbal Behavior*, *33*(1), 17–34.

Ambadar, Z., Schooler, J. W., & Cohn, J. F. (2005). Deciphering the enigmatic face the importance of facial dynamics in interpreting subtle facial expressions. *Psychological Science*, *16*(5), 403–410.

Ambady, N., Bernieri, F. J., & Richeson, J. A. (2000). Toward a histology of social behavior: Judgmental accuracy from thin slices of the behavioral stream. *Advances* *in Experimental Social Psychology*, *32*, 201–271.

Ambady, N., & Rosenthal, R. (1992). Thin slices of expressive behavior as predictors of interpersonal consequences: A meta-analysis. *Psychological Bulletin*, *111*(2), 256.

Andersen, P. A., Guerrero, L. K., & Jones, S. M. (2006). Nonverbal behavior in intimate interactions and intimate relationships. *The Sage Handbook of Nonverbal Communication*, 259–277.

Anderson, C., & Berdahl, J. L. (2002). The experience of power: examining the effects of power on approach and inhibition tendencies. *Journal of Personality and Social Psychology*, *83*(6), 1362.

Anderson, C., & Galinsky, A. D. (2006). Power, optimism, and risk-taking. *European Journal of Social Psychology*, *36*(4), 511–536.

Anderson, C., John, O. P., Keltner, D., & Kring, A. M. (2001). Who attains social status? Effects of personality and physical attractiveness in social groups. *Journal of Personality and Social Psychology*, *81*(1), 116.

Anderson, D. E., DePaulo, B. M., Ansfield, M. E., Tickle, J. J., & Green, E. (1999). Beliefs about cues to deception: Mindless Stereotypes or Untapped Wisdom? *Journal of Nonverbal Behavior*, *23*(1), 67–89.

Arcimowicz, B., Cantarero, K., & Soroko, E. (2015). Motivation and Consequences of Lying. A Qualitative Analysis of Everyday Lying. In *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* (Vol. 16).

Arsalidou, M., Morris, D., & Taylor, M. J. (2011). Converging evidence for the advantage of dynamic facial expressions. *Brain Topography*, *24*(2), 149–163.

Bachorowski, J.-A., & Owren, M. J. (2003). Sounds of emotion: production and perception of affect-related vocal acoustics. *Annals of the New York Academy of Sciences*, *1000*, 244–265.

Bahrami, B., Olsen, K., Bang, D., Roepstorff, A., Rees, G., & Frith, C. (2012). Together, slowly but surely: the role of social interaction and feedback on the build-up of benefit in collective decision-making. *Journal of Experimental Psychology: Human*

*Perception and Performance*, *38*(1), 3.

Bahrami, B., Olsen, K., Latham, P. E., Roepstorff, A., Rees, G., & Frith, C. D. (2010). Optimally interacting minds. *Science*, *329*(5995), 1081–1085.

Baker, A., ten Brinke, L. M., & Porter, S. (2013). Will get fooled again: Emotionally intelligent people are easily duped by high-stakes deceivers: *Emotional intelligence and deception detection*. *Legal and Criminological Psychology*, *18*(2), 300–313.

Banissy, M. J., Kanai, R., Walsh, V., & Rees, G. (2012). Inter-individual differences in empathy are reflected in human brain structure. *Neuroimage*, *62*(3), 2034–2039.

Bänziger, T., & Scherer, K. R. (2007). Using actor portrayals to systematically study multimodal emotion expression: The GEMEP corpus. In *International Conference on Affective Computing and Intelligent Interaction* (pp. 476–487). Springer.

Bänziger, T., & Scherer, K. R. (2010). Introducing the geneva multimodal emotion portrayal (gemep) corpus. *Blueprint for Affective Computing: A Sourcebook*, 271–294.

Bänziger, T., Scherer, K. R., Hall, J. A., & Rosenthal, R. (2011). Introducing the MiniPONS: a short multichannel version of the profile of nonverbal sensitivity (PONS). *J Nonverbal Behav*, *35*.

Baron, R. S. (2005). So right it's wrong: Groupthink and the ubiquitous nature of polarized group decision making. *Advances in Experimental Social Psychology*, *37*, 219–253.

Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y., & Plumb, I. (2001). The "reading the mind in the eyes" test revised version: a study with normal adults, and adults with asperger syndrome or high-functioning autism. *J Child Psychol Psychiatry*, *42*.

Barrett, H. C., Todd, P. M., Miller, G. F., & Blythe, P. W. (2005). Accurate judgments of intention from motion cues alone: A cross-cultural study. *Evolution and Human Behavior*, *26*(4), 313–331.

Barrett, L. F. (1998). Discrete emotions or dimensions? The role of valence focus and arousal focus. *Cognition & Emotion*, *12*(4), 579–599.

Barrett, L. F. (2006). Are emotions natural kinds? *Perspectives on Psychological Science*, *1*(1), 28–58.

Barrett, L. F. (2011). Was Darwin Wrong About Emotional Expressions? *Current Directions in Psychological Science*, *20*(6), 400–406.

Barrett, L. F., & Bliss-Moreau, E. (2009). Affect as a psychological primitive. *Advances in Experimental Social Psychology*, *41*, 167–218.

Barsalou, L. W., Niedenthal, P. M., Barbey, A. K., & Ruppert, J. A. (2003). Social embodiment. *Psychology of Learning and Motivation*, *43*, 43–92.

Bartholow, B. D., Sestir, M. A., & Davis, E. B. (2005). Correlates and consequences of exposure to video game violence: Hostile personality, empathy, and aggressive behavior. *Personality and Social Psychology Bulletin*, *31*(11), 1573–1586.

Bartz, J. A., Zaki, J., Bolger, N., Hollander, E., Ludwig, N. N., Kolevzon, A., & Ochsner, K. N. (2010). Oxytocin selectively improves empathic accuracy. *Psychological Science*, *21*(10), 1426–1428.

Beattie, G. (2004). *Visible thought: The new psychology of body language*. Psychology Press.

Beattie, G. (2016). *Rethinking Body Language: How Hand Movements Reveal Hidden Thoughts*. Psychology Press.

Beattie, G., & Shovelton, H. (1999). Mapping the range of information contained in the iconic hand gestures that accompany spontaneous speech. *Journal of Language and Social Psychology*, *18*(4), 438–462.

Beigel, H. G. (1952). The influence of body position on mental processes. *Journal of Clinical Psychology*, *8*(2), 193–199.

Bem, D. J. (1972). Self-perception theory. *Advances in Experimental Social Psychology*, *6*, 1–62.

Berenbaum, H., & Rotter, A. (1992). The relationship between spontaneous facial expressions of emotion and voluntary control of facial muscles. *Journal of Nonverbal Behavior*, *16*(3), 179–190.

Berlin, H. A., Rolls, E. T., & Kischka, U. (2004). Impulsivity, time perception, emotion and reinforcement sensitivity in patients with orbitofrontal cortex lesions. *Brain*, *127*(5), 1108–1126.

Bernstein, P. (1973). Recapitulation of ontogeny: A theoretical approach in dance movement therapy. In D. Plunk-Burdick & S. Chaiklin (Eds.), *Dance therapist in dimension: Depth and diversity* (pp. 107–115). Columbia, MD: American Dance Therapy Association.

Besel, L. D. S., & Yuille, J. C. (2010). Individual differences in empathy: The role of facial expression recognition. *Personality and Individual Differences*, *49*(2), 107–112.

Blair, J. P., Levine, T. R., & Shaw, A. S. (2010). Content in Context Improves Deception Detection Accuracy. *Human Communication Research*, *36*(3), 423–442.

Blair, J. P., Levine, T. R., & Vasquez, B. E. (2015). Producing deception detection expertise. *Policing: An International Journal of Police Strategies & Management*, *38*(1), 71–85.

Blairy, S., Herrera, P., & Hess, U. (1999). Mimicry and the judgment of emotional facial expressions. *Journal of Nonverbal Behavior*, *23*(1), 5–41.

Blanch-Hartigan, D., Andrzejewski, S. A., & Hill, K. M. (2012). The effectiveness of training to improve person perception accuracy: a meta-analysis. *Basic and Applied Social Psychology*, *34*(6), 483–498.

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*(6),

Bolinger, D. (1973). Truth is a linguistic question. *Language*, 539–550.

Bond, C. F., & DePaulo, B. M. (2006). Accuracy of deception judgments. *Personality and Social Psychology Review*, *10*(3), 214–234.

Bond, C. F., & DePaulo, B. M. (2008). Individual differences in judging deception: Accuracy and bias. *Psychological Bulletin*, *134*(4), 477–492.

Bond, C. F., & Fahey, W. E. (1987). False suspicion and the misperception of deceit. *British Journal of Social Psychology*, *26*(1), 41–46.

Bond, C. F., Howard, A. R., Hutchison, J. L., & Masip, J. (2013). Overlooking the Obvious: Incentives to Lie. *Basic and Applied Social Psychology*, *35*(2), 212–221.

Bond, C. F., Omar, A., Pitre, U., Lashley, B. R., Skaggs, L. M., & Kirk, C. T. (1992). Fishylooking liars: deception judgment from expectancy violation. *Journal of Personality and Social Psychology*, *63*(6), 969.

Bond, C. F., & Robinson, M. (1988). The evolution of deception. *Journal of Nonverbal Behavior*, *12*(4), 295–307.

Bond, C. F., & Uysal, A. (2007). On lie detection "wizards." *Law and Human Behavior*, *31*(1), 109–115.

Bond, G. D. (2008). Deception detection expertise. *Law and Human Behavior*, *32*(4), 339–351.

Boothroyd, L. G., Cross, C. P., Gray, A. W., Coombes, C., & Gregson-Curtis, K. (2011). Perceiving the facial correlates of sociosexuality: Further evidence. *Personality and Individual Differences*, *50*(3), 422–425.

Borghi, A. M., & Pecher, D. (2011). Introduction to the special topic embodied and grounded cognition. *Embodied and Grounded Cognition*, 5.

Bornstein, G., Kugler, T., & Ziegelmeyer, A. (2004). Individual and group decisions in the centipede game: Are groups more "rational" players? *Journal of Experimental Social Psychology*, *40*(5), 599–605.

Bourgeois, P., & Hess, U. (2008). The impact of social context on mimicry. *Biological Psychology*, *77*(3), 343–352.

Boyatzis, C. J., & Satyaprasad, C. (1994). Children's facial and gestural decoding and encoding: Relations between skills and with popularity. *Journal of Nonverbal Behavior*, *18*(1), 37–55.

Brennan, S. E., Chen, X., Dickinson, C. A., Neider, M. B., & Zelinsky, G. J. (2008). Coordinating cognition: The costs and benefits of shared gaze during collaborative search. *Cognition*, *106*(3), 1465–1477.

Brewer, M. B. (1999). The psychology of prejudice: Ingroup love and outgroup hate? *Journal of Social Issues*, *55*(3), 429–444.

Briñol, P., & Petty, R. E. (2008). Embodied persuasion: Fundamental processes by which bodily responses can impact attitudes. *Embodiment Grounding: Social, Cognitive,* *Affective, and Neuroscientific Approaches*, 184–207.

Briñol, P., Petty, R. E., & Wagner, B. (2009). Body posture effects on self-evaluation: A self-validation approach. *European Journal of Social Psychology*, *39*(6), 1053–1064.

Brunswik, E. (1955). Representative design and probabilistic theory in a functional psychology. *Psychological Review*, *62*(3), 193.

Buck, R. (1999). The biological affects: a typology. *Psychological Review*, *106*(2), 301.

Buckley, J. P. (2012). Detection of deception researchers needs to collaborate with experienced practitioners. *Journal of Applied Research in Memory and Cognition*, *1*(2), 126–127.

Bugental, D. B., Shennum, W., Frank, M., & Ekman, P. (2001). " True Lies": Children's abuse history and power attributions as influences on deception detection. In V. Manusov & J. H. Harvey (Eds.), Attribution, communication behavior, and close relationships, (pp. 248-265). New York, NY, US: Cambridge University Press.

Bull, P. (1987). *Gesture and posture*. Oxford, England Pergamon Press.

Bull, R., & Milne, R. (1999). *Investigative Interviewing, Psychology and Practice*. West Sussex, UK: John Wiley & Sons, LTD.

Buller, D. B., & Burgoon, J. K. (1996). Interpersonal deception theory. *Communication Theory*, *6*(3), 203–242.

Buller, D. B., Strzyzewski, K. D., & Comstock, J. (1991). Interpersonal deception: I. Deceivers' reactions to receivers' suspicions and probing. *Communications Monographs*, *58*(1), 1–24.

Buller, D. B., Strzyzewski, K. D., & Hunsaker, F. G. (1991). Interpersonal deception: II. The inferiority of conversational participants as deception detectors. *Communication Monographs*, *58*(1), 25–40.

Burgoon, J. K., Blair, J. P., & Strom, R. E. (2008). Cognitive Biases and Nonverbal Cue Availability in Detecting Deception. *Human Communication Research*, *34*(4), 572–599.

Burgoon, J. K., & Buller, D. B. (1994). Interpersonal deception: III. Effects of deceit on perceived communication and nonverbal behavior dynamics. *Journal of Nonverbal Behavior*, *18*(2), 155–184.

Burgoon, J. K., Buller, D. B., Dillman, L., & Walther, J. B. (1995). Interpersonal deception. *Human Communication Research*, *22*(2), 163–196.

Burgoon, J. K., Buller, D. B., Ebesu, A. S., & Rockwell, P. (1994). Interpersonal deception: V. Accuracy in deception detection. *Communications Monographs*, *61*(4), 303–325.

Burgoon, J. K., Buller, D. B., Ebesu, A. S., White, C. H., & Rockwell, P. A. (1996). Testing Interpersonal Deception Theory: Effects of Suspicion on Communication Behaviors and Perceptions. *Communication Theory*, *6*(3), 243–267.

Burgoon, J. K., Buller, D. B., Floyd, K., & Grandpre, J. (1996). Deceptive realities sender, receiver, and observer perspectives in deceptive conversations. *Communication Research*, *23*(6), 724–748.

Burgoon, J. K., Buller, D. B., White, C. H., Afifi, W., & Buslig, A. L. (1999). The role of conversational involvement in deceptive interpersonal interactions. *Personality and Social Psychology Bulletin*, *25*(6), 669–686.

Burgoon, J. K., & Newton, D. A. (1991). Applying a social meaning model to relational message interpretations of conversational involvement: Comparing observer and participant perspectives. *Southern Journal of Communication*, *56*(2), 96–113.

Burns, M. B., & Moffitt, K. C. (2014). Automated deception detection of 911 call transcripts. *Security Informatics*, *3*(1), 1–9.

Byron, K., Terranova, S., & Nowicki, S. (2007). Nonverbal emotion recognition and salespersons: Linking ability to perceived and actual success. *Journal of Applied Social Psychology*, *37*(11), 2600–2619.

Cacioppo, J. T., Marshall-Goodell, B. S., Tassinary, L. G., & Petty, R. E. (1992). Rudimentary determinants of attitudes: Classical conditioning is more effective when prior knowledge about the attitude stimulus is low than high. *Journal of Experimental Social Psychology*, *28*(3), 207–233.

Calder, A. J., Keane, J., Manes, F., Antoun, N., & Young, A. W. (2000). Impaired recognition and experience of disgust following brain injury. *Nature Neuroscience*, *3*(11), 1077–1078.

Calvo, M. G., Gutiérrez-García, A., Avero, P., & Lundqvist, D. (2013). Attentional mechanisms in judging genuine and fake smiles: Eye-movement patterns. *Emotion*, *13*(4), 792.

Calvo, M. G., Gutiérrez-García, A., Fernández-Martín, A., & Nummenmaa, L. (2014). Recognition of Facial Expressions of Emotion is Related to their Frequency in Everyday Life. *Journal of Nonverbal Behavior*, *38*(4), 549–567.

Carney, D. R., Colvin, C. R., & Hall, J. A. (2007). A thin slice perspective on the accuracy of first impressions. *Journal of Research in Personality*, *41*(5), 1054–1072.

Carney, D. R., Cuddy, A. J. C., & Yap, A. J. (2010). Power Posing: Brief Nonverbal Displays Affect Neuroendocrine Levels and Risk Tolerance. *Psychological Science*, *21*(10), 1363–1368.

Carney, D. R., Dubois, D., Nichiporuk, N., ten Brinke, L. M., Rucker, D. D., & Galinsky, A. D. (2013). The deception equilibrium: The powerful are better liars but the powerless are better lie-detectors. *Manuscript Submitted for Publication*.

Carr, E. W., Korb, S., Niedenthal, P. M., & Winkielman, P. (2014). The two sides of spontaneity: Movement onset asymmetries in facial expressions influence social judgments. *Journal of Experimental Social Psychology*, *55*, 31–36.

Carr, M. B., & Lutjemeier, J. A. (2005). The relation of facial affect recognition and empathy to delinquency in youth offenders. *Adolescence*, *40*(159), 601.

Carrera-Levillain, P., & Fernandez-Dols, J.-M. (1994). Neutral faces in context: Their emotional meaning and their function. *Journal of Nonverbal Behavior*, *18*(4), 281–299.

Carroll, J. M., & Russell, J. A. (1997). Facial expressions in Hollywood's protrayal of emotion. *Journal of Personality and Social Psychology*, *72*(1), 164.

Carton, J. S., Kessler, E. A., & Pape, C. L. (1999). Nonverbal decoding skills and relationship well-being in adults. *Journal of Nonverbal Behavior*, *23*(1), 91–100.

Caruana, F., Jezzini, A., Sbriscia-Fioretti, B., Rizzolatti, G., & Gallese, V. (2011). Emotional and social behaviors elicited by electrical stimulation of the insula in the macaque monkey. *Current Biology*, *21*(3), 195–199.

Caso, L., Gnisci, A., Vrij, A., & Mann, S. (2005). Processes underlying deception: an empirical analysis of truth and lies when manipulating the stakes. *Journal of Investigative Psychology and Offender Profiling*, *2*(3), 195–202.

Caso, L., Maricchiolo, F., Bonaiuto, M., Vrij, A., & Mann, S. (2006). The impact of deception and suspicion on different hand movements. *Journal of Nonverbal Behavior*, *30*(1), 1–19.

Castellano, G., Villalba, S. D., & Camurri, A. (2007). Recognising human emotions from body movement and gesture dynamics. In *International Conference on Affective Computing and Intelligent Interaction* (pp. 71–82). Springer.

Cesario, J., & McDonald, M. M. (2013). Bodies in context: Power poses as a computation of action possibility. *Social Cognition*, *31*(2), 260.

Chartrand, T. L., & Bargh, J. A. (1999). The chameleon effect: The perception–behavior link and social interaction. *Journal of Personality and Social Psychology*, *76*(6), 893.

Chepenik, L. G., Cornew, L. A., & Farah, M. J. (2007). The influence of sad mood on cognition. *Emotion*, *7*(4), 802.

Chikovani, G., Babuadze, L., Iashvili, N., Gvalia, T., & Surguladze, S. (2015). Empathy costs: Negative emotional bias in high empathisers. *Psychiatry Research*, *229*(1), 340–346.

Chong, S. C. F., Werker, J. F., Russell, J. A., & Carroll, J. M. (2003). Three facial expressions mothers direct to their infants. *Infant and Child Development*, *12*(3), 211–232.

Christ, S. E., Van Essen, D. C., Watson, J. M., Brubaker, L. E., & McDermott, K. B. (2009). The contributions of prefrontal cortex and executive control to deception: evidence from activation likelihood estimate meta-analyses. *Cerebral Cortex*, *19*(7), 1557–1566.

Christie, R. G., & Geis, F. (1970). *Studies in Machiavellianism*. New York, NY: Academic Press.

Church, R. B., & Goldin-Meadow, S. (1986). The mismatch between gesture and speech as an index of transitional knowledge. *Cognition*, *23*(1), 43–71.

Clark, A. (1999). An embodied cognitive science? *Trends in Cognitive Sciences*, *3*(9), 345–351.

Cleary, H. M. D., & Warner, T. C. (2016). Police training in interviewing and interrogation methods: A comparison of techniques used with adult and juvenile suspects. *Law and Human Behavior*,

Coan, J. A., & Allen, J. J. (2007). *Handbook of emotion elicitation and assessment.* Oxford university press.

Cole, T. (2001). Lying to the one you love: The use of deception in romantic relationships. *Journal of Social and Personal Relationships*, *18*(1), 107–129.

Colwell, L. H., Miller, H. A., Lyons, P. M., & Miller, R. S. (2006). The training of law enforcement officers in detecting deception: A survey of current practices and suggestions for improving accuracy. *Police Quarterly*, *9*(3), 275–290.

Conson, M., Ponari, M., Monteforte, E., Ricciato, G., Sarà, M., Grossi, D., & Trojano, L. (2013). Explicit recognition of emotional facial expressions is shaped by expertise: evidence from professional actors. *Frontiers in Psychology*, *4*.

Costa, T., Cauda, F., Crini, M., Tatu, M.-K., Celeghin, A., de Gelder, B., & Tamietto, M. (2013). Temporal and spatial neural dynamics in the perception of basic emotions from complex scenes. *Social Cognitive and Affective Neuroscience*, 164.

Crivelli, C., Jarillo, S., Russell, J. A., & Fernández-Dols, J.-M. (2016). Reading emotions from faces in two indigenous societies. *Journal of Experimental Psychology: General*, *145*(7), 830–843.

Crozier, W. R. (2010). The Puzzle of Blushing. *The Psychologist*, *23*(5), 390–393.

Cui, Q., Vanman, E. J., Wei, D., Yang, W., Jia, L., & Zhang, Q. (2013). Detection of deception based on fMRI activation patterns underlying the production of a deceptive response and receiving feedback about the success of the deception after a mock murder crime. *Social Cognitive and Affective Neuroscience*, 134.

Culhane, S. E., Kehn, A., Hatz, J., & Hildebrand, M. M. (2015). Are two heads better than one? Assessing the influence of collaborative judgements and presentation mode on deception detection for real and mock transgressions. *Journal of Investigative Psychology and Offender Profiling*, *12*(2), 158–170.

Danckert, J., & Goodale, M. A. (2000). Blindsight: A conscious route to unconscious vision. *Current Biology*, *10*(2), 64–67.

Darwin, C. (1872). *The origin of species*. Lulu. com.

Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multi-dimensional approach. *Journal of Personality and Social Psychology*, *44*(1), 113.

Davis, M. H., & Franzoi, S. L. (1991). Stability and change in adolescent self-consciousness and empathy. *Journal of Research in Personality*, *25*(1), 70–87.

DeCaro, M. S., Thomas, R. D., Albert, N. B., & Beilock, S. L. (2011). Choking under pressure: multiple routes to skill failure. *Journal of Experimental Psychology: General*, *140*(3), 390.

Decety, J. (2004). L'empathie est-elle une simulation mentale de la subjectivité d'autrui. *L'empathie. Paris: Odile Jacob*, 53–88.

Decety, J., & Jackson, P. L. (2006). A social-neuroscience perspective on empathy. *Current Directions in Psychological Science*, *15*(2), 54–58.

Decety, J., & Lamm, C. (2006). Human empathy through the lens of social neuroscience. *The Scientific World Journal*, *6*, 1146–1163.

DeGroot, T., & Gooty, J. (2009). Can nonverbal cues be used to make meaningful personality attributions in employment interviews? *Journal of Business and Psychology*, *24*(2), 179–192.

Dennis, A. R., & Kinney, S. T. (1998). Testing media richness theory in the new media: The effects of cues, feedback, and task equivocality. *Information Systems Research*, *9*(3), 256–274.

DePaulo, B. M. (1992). Nonverbal behavior and self-presentation. *Psychological Bulletin*, *111*(2), 203.

DePaulo, B. M., Charlton, K., Cooper, H., Lindsay, J. J., & Muhlenbruck, L. (1997). The accuracy-confidence correlation in the detection of deception. *Personality and Social Psychology Review*, *1*(4), 346–357.

DePaulo, B. M., Epstein, J. A., & Wyer, M. M. (1993). Sex differences in lying: How women and men deal with the dilemma of deceit.

DePaulo, B. M., & Kashy, D. A. (1998). Everyday lies in close and casual relationships. *Journal of Personality and Social Psychology*, *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*(5), 979.

DePaulo, B. M., Kirkendol, S. E., Tang, J., & O'Brien, T. P. (1988). The motivational impairment effect in the communication of deception: Replications and extensions. *Journal of Nonverbal Behavior*, *12*(3), 177–202.

DePaulo, B. M., Lanier, K., & Davis, T. (1983). Detecting the deceit of the motivated liar. *Journal of Personality and Social Psychology*, *45*(5), 1096.

DePaulo, B. M., Lassiter, G. D., & Stone, J. I. (1982). Attentional determinants of success at detecting deception and truth. *Personality and Social Psychology Bulletin*, *8*(2), 273–279.

DePaulo, B. M., LeMay, C. S., & Epstein, J. A. (1991). Effects of importance of success and expectations for success on effectiveness at deceiving. *Personality and Social Psychology Bulletin*, *17*(1), 14–24.

DePaulo, B. M., Lindsay, J. J., Malone, B. E., Muhlenbruck, L., Charlton, K., & Cooper, H. (2003). Cues to deception. *Psychological Bulletin*, *129*(1), 74–118.

DePaulo, B. M., & Pfeifer, R. L. (1986). On-the-Job Experience and Skill at Detecting Deception1. *Journal of Applied Social Psychology*, *16*(3), 249–267.

DePaulo, B. M., & Rosenthal, R. (1979). Telling lies. *Journal of Personality and Social Psychology*, *37*(10), 1713.

DePaulo, B. M., Stone, J. I., & Lassiter, G. D. (1985). Deceiving and detecting deceit. In Schlenker, B. R. (Ed.), *The self and social life* (pp. 323–370). New York, NY: McGraw-Hill.

DePaulo, B. M., Zuckerman, M., & Rosenthal, R. (1980). Detecting deception. Modality effects. In Wheeler, L. (Ed.), *Review of personality and social psychology* (Vol. 1, pp. 125–162).

DePaulo, P. J., & DePaulo, B. M. (1989). Can Deception by Salespersons and Customers Be Detected Through Nonverbal Behavioral Cues? 1. *Journal of Applied Social Psychology*, *19*(18), 1552–1577.

Derntl, B., Finkelmeyer, A., Eickhoff, S., Kellermann, T., Falkenberg, D. I., Schneider, F., & Habel, U. (2010). Multidimensional assessment of empathic abilities: neural correlates and gender differences. *Psychoneuroendocrinology*, *35*(1), 67–82.

DesJardins, N. M. L., & Hodges, S. D. (2015). Reading Between the Lies Empathic Accuracy and Deception Detection. *Social Psychological and Personality Science*, *6*(7), 781–787.

DeTurck, M. A., & Miller, G. R. (1985). Deception and arousal: Isolating the behavioral correlates of deception. *Human Communication Research*, *12*(2), 181-201.

DeTurck, M. A., & Miller, G. R. (1990). Training Observers to Detect Deception Effects of Self-Monitoring and Rehearsal. *Human Communication Research*, *16*(4), 603–620.

Dezecache, G., Mercier, H., & Scott-Phillips, T. C. (2013). An evolutionary approach to emotional communication. *Journal of Pragmatics*, *59*, 221–233.

Díaz-Galván, K. X., Ostrosky-Shejet, F., & Romero-Rebollar, C. (2015). Cognitive and affective empathy: The role in violent behavior and psychopathy. *Revista Médica Del Hospital General De México*, *78*(1), 27–35.

Dijk, C., Koenig, B., Ketelaar, T., & de Jong, P. J. (2011). Saved by the blush: being trusted despite defecting. *Emotion*, *11*(2), 313.

Dimberg, U. (1990). Facial electromyography and emotional reactions. *Psychophysiology*, *27*(5), 481-94.

Dimberg, U., Andréasson, P., & Thunberg, M. (2011). Emotional Empathy and Facial Reactions to Facial Expressions. *Journal of Psychophysiology*, *25*(1), 26–31.

Dimberg, U., & Thunberg, M. (1998). Rapid facial reactions to emotional facial expressions. *Scandinavian Journal of Psychology*, *39*(1), 39–45.

D'Mello, S., Chipman, P., & Graesser, A. (2007). Posture as a predictor of learner's affective engagement. In *Proceedings of the 29th annual cognitive science society* (Vol. 1, pp. 905–910). Citeseer.

Dobson, S. D. (2009). Socioecological correlates of facial mobility in nonhuman anthropoids. *American Journal of Physical Anthropology*, *139*(3), 413–420.

Donaldson, W. (1992). Measuring recognition memory. *Journal of Experimental Psychology: General*, *121*(3), 275.

Dondi, M., Simion, F., & Caltran, G. (1999). Can newborns discriminate between their own cry and the cry of another newborn infant? *Developmental Psychology*, *35*(2), 418.

Driskell, J. E. (2012). Effectiveness of deception detection training: A meta-analysis. *Psychology, Crime & Law*, *18*(8), 713–731.

Duchenne, d B. (1862). *The mechanism of human facial expression or an electro-physiological analysis of the expression of the emotions (A. Cuthbertson, Trans.)*. New York: Cambridge University Press.

Dumas, G. (1932). La mimique des aveugles. *Bulletin de l'Académie de Médecine*, *107*, 607-10.

Dunbar, N. E., Gangi, K., Coveleski, S., Adams, A., Bernhold, Q., & Giles, H. (2016). When Is It Acceptable to Lie? Interpersonal and Intergroup Perspectives on Deception. *Communication Studies*, *67*(2), 129–146.

Dunn, J. (2000). Mind-reading, emotion understanding, and relationships. *International Journal of Behavioral Development*, *24*(2), 142–144.

Duran, N. D., Dale, R., Kello, C. T., Street, C. N. H., & Richardson, D. C. (2013). Exploring the movement dynamics of deception. *Frontiers in Psychology*, *4*.

Edelman, G. (2006). Second nature: the transformation of knowledge. *Second Nature: Brain Science and Human Knowledge*, 142–57.

Eimer, M., & Holmes, A. (2007). Event-related brain potential correlates of emotional face processing. *Neuropsychologia*, *45*(1), 15–31.

Einav, S., & Hood, B. M. (2008). Tell-tale eyes: children's attribution of gaze aversion as a lying cue. *Developmental Psychology*, *44*(6), 1655.

Ekman, P. (1988). Lying and nonverbal behavior: Theoretical issues and new findings. *Journal of Nonverbal Behavior*, *12*(3), 163–175.

Ekman, P. (1989). Why lies fail and what behaviors betray a lie. In *Credibility assessment* (pp. 71–81). Springer.

Ekman, P. (1994). All emotions are basic. *The Nature of Emotion: Fundamental Questions*, 15–19.

Ekman, P. (1997). Deception, lying, and demeanor. *States of Mind: American and Post-Soviet Perspectives on Contemporary Issues in Psychology*, 93–105.

Ekman, P. (1999). Facial expressions. In Dalgleish, T. & Power, M. (Eds.), *Handbook of Cognition and Emotion* (pp. 301–320). New York, NY: Wiley.

Ekman, P. (2002). *Microexpression Training Tool, Subtle Expression Training Tool*. Salt Lake City, UT: A Human Face.

Ekman, P. (2003a). Darwin, deception, and facial expression. *Annals of the New York Academy of Sciences*, *1000*(1), 205–221.

Ekman, P. (2003b). *Emotions revealed: Recognizing faces and feelings to improve communication and emotional life*. New York, NY: Owl Books.

Ekman, P. (2003c). Sixteen enjoyable emotions. *Emotion Researcher*, *18*(2), 6–7.

Ekman, P. (2004). Emotional and conversational nonverbal signals. In *Language, knowledge, and representation* (pp. 39–50). Springer.

Ekman, P. (2005). Facial Expressions. In *Handbook of Cognition and Emotion* (pp. 301–320). John Wiley & Sons, Ltd.

Ekman, P. (2009a). Lie catching and microexpressions. *The Philosophy of Deception*, 118–133.

Ekman, P. (2009b). *Telling lies: Clues to deceit in the marketplace, politics, and marriage* *(revised edition)*. WW Norton & Company.

Ekman, P., Davidson, R. J., & Friesen, W. V. (1990). The Duchenne smile: Emotional expression and brain physiology: II. *Journal of Personality and Social Psychology*, *58*(2), 342.

Ekman, P., & Frank, M. G. (1993). *Lies that fail.* In Lewis, M. & Saarni, C. (Eds.), Lying and deception in everyday life (pp. 184-200). New York: Guilford Press.

Ekman, P., Freisen, W. V., & Ancoli, S. (1980). Facial signs of emotional experience. *Journal of Personality and Social Psychology*, *39*(6), 1125.

Ekman, P., & Friesen, W. V. (1967). Head and body cues in the judgment of emotion: A reformulation. *Perceptual and Motor Skills*, *24*(3 PT 1), 711–724.

Ekman, P., & Friesen, W. V. (1969). Nonverbal leakage and clues to deception. *Psychiatry*, *32*(1), 88–106.

Ekman, P., & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology*, *17*(2), 124.

Ekman, P., & Friesen, W. V. (1972). Hand movements. *Journal of Communication*, *22*(4), 353–374.

Ekman, P., & Friesen, W. V. (1974). Detecting deception from the body or face. *Journal of Personality and Social Psychology*, *29*(3), 288–298.

Ekman, P., & Friesen, W. V. (1976). Measuring facial movement. *Environmental Psychology and Nonverbal Behavior*, *1*(1), 56–75.

Ekman, P., & Friesen, W. V. (1982). Felt, false, and miserable smiles. *Journal of Nonverbal Behavior*, *6*(4), 238–252.

Ekman, P., & Friesen, W. V. (1986). A new pan-cultural facial expression of emotion. *Motivation and Emotion*, *10*(2), 159–168.

Ekman, P., Friesen, W. V., & Hager, J. (1978). The Facial Action Coding System (FACS): A technique for the measurement of facial action. Palo Alto. *Palo Alto: Consulting Psychologists*.

Ekman, P., Friesen, W. V., & O'Sullivan, M. (1988). Smiles when lying. *Journal of*

*Personality and Social Psychology*, *54*(3), 414.

Ekman, P., Friesen, W. V., O'Sullivan, M., Chan, A., Diacoyanni-Tarlatzis, I., Heider, K.,… Ricci-Bitti, P. E. (1987). Universals and cultural differences in the judgments of facial expressions of emotion. *Journal of Personality and Social Psychology*, *53*(4), 712.

Ekman, P., & Heider, K. G. (1988). The universality of a contempt expression: A replication. *Motivation and Emotion*, *12*(3), 303–308.

Ekman, P., Levenson, R. W., & Friesen, W. V. (1983). Autonomic nervous system activity distinguishes among emotions. *Science*, *221*(4616), 1208–1210.

Ekman, P., & O'Sullivan, M. (1991). Who can catch a liar? *American Psychologist*, *46*(9), 913–920.

Ekman, P., & O'Sullivan, M. (2006). From flawed self-assessment to blatant whoppers: the utility of voluntary and involuntary behavior in detecting deception. *Behavioral Sciences & the Law*, *24*(5), 673–686.

Ekman, P., O'Sullivan, M., & Frank, M. G. (1999). A few can catch a liar. *Psychological Science*, *10*(3), 263–266.

Ekman, P., O'Sullivan, M., Friesen, W. V., & Scherer, K. R. (1991). Invited article: Face, voice, and body in detecting deceit. *Journal of Nonverbal Behavior*, *15*(2), 125–135.

Ekman, P., Roper, G., & Hager, J. C. (1980). Deliberate facial movement. *Child Development*, 886–891.

Ekman, P., & Rosenberg, E. (2005). *What the face reveals. 2nd*. Oxford New York:

Elaad, E. (2003). Effects of feedback on the overestimated capacity to detect lies and the underestimated ability to tell lies. *Applied Cognitive Psychology*, *17*(3), 349–363.

Elfenbein, H. A., & Ambady, N. (2002). On the universality and cultural specificity of emotion recognition: a meta-analysis. *Psychological Bulletin*, *128*(2), 203.

Elfenbein, H. A., Beaupré, M., Lévesque, M., & Hess, U. (2007). Toward a dialect theory: Cultural differences in the expression and recognition of posed facial expressions. *Emotion*, *7*(1), 131–146.

Ellsworth, P. C., & Scherer, K. R. (2003). Appraisal processes in emotion. *Handbook of Affective Sciences*, *572*, V595.

Endres, J., & Laidlaw, A. (2009). Micro-expression recognition training in medical students: a pilot study. *BMC Medical Education*, *9*(1), 47.

Etcoff, N. L., Ekman, P., Magee, J. J., & Frank, M. G. (2000). Lie detection and language comprehension. *Nature*, *405*(6783), 139–139.

Evanoff, C., Porter, S., & Black, P. J. (2014). Video killed the radio star? The influence of presentation modality on detecting high-stakes, emotional lies. *Legal and Criminological Psychology*, *21*(2), 332-343.

Evans, A. D., & Lee, K. (2013). Emergence of lying in very young children. *Developmental Psychology*, *49*(10), 1958.

Feeley, T. H. (1996). Exploring sanctioned and unsanctioned lies in interpersonal deception. *Communication Research Reports*, *13*(2), 164–173.

Feeley, T. H. (1998). The behavioral correlates of sanctioned and unsanctioned deceptive communication. *Journal of Nonverbal Behavior*, *22*(3), 189–204.

Feeley, T. H., & deTurck, M. A. (1997). Perceptions of communications as seen by the actor and as seen by the observer: The case of lie detection. In *International Communication Association Annual Conference, Montreal, Canada*.

Feeley, T. H., deTurck, M. A., & Young, M. J. (1995). Baseline familiarity in lie detection. *Communication Research Reports*, *12*(2), 160–169.

Feeley, T. H., & Young, M. J. (1998). Humans as lie detectors: Some more second thoughts. *Communication Quarterly*, *46*(2), 109–126.

Feeley, T. H., & Young, M. J. (2000). Self-reported cues about deceptive and truthful communication: The effects of cognitive capacity and communicator veracity. *Communication Quarterly*, *48*(2), 101–119.

Feldman, R. S., Coats, E. J., & Spielman, D. A. (1996). Television Exposure and Children's Decoding of Nonverbal Behavior1. *Journal of Applied Social Psychology*, *26*(19), 1718–1733.

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*(2), 163–170.

Fernández-Abascal, E. G., Cabello, R., Fernández-Berrocal, P., & Baron-Cohen, S. (2013). Test-retest reliability of the "Reading the Mind in the Eyes" test: a one-year follow-up study. *Molecular Autism*, *4*(1), 1–6.

Fernández-Dols, J.-M., Wallbott, H., & Sanchez, F. (1991). Emotion category accessibility and the decoding of emotion from facial expression and context. *Journal of Nonverbal Behavior*, *15*(2), 107–123.

Feyereisen, P. (1983). Manual activity during speaking in aphasic subjects. *International Journal of Psychology*, *18*(1–4), 545–556.

Fischer, A. H., & Manstead, A. S. (2008). Social functions of emotion. *Handbook of Emotions*, *3*, 456–468.

Forrest, J. A., & Feldman, R. S. (2000). Detecting deception and judge's involvement: Lower task involvement leads to better lie detection. *Personality and Social Psychology Bulletin*, *26*(1), 118–125.

Forrest, J. A., Feldman, R. S., & Tyler, J. M. (2004). When accurate beliefs lead to better lie detection1. *Journal of Applied Social Psychology*, *34*(4), 764–780.

Förster, J., & Strack, F. (1996). Influence of overt head movements on memory for valenced words: a case of conceptual-motor compatibility. *Journal of Personality and Social Psychology*, *71*(3), 421.

Fowler, K. A., Lilienfeld, S. O., & Patrick, C. J. (2009). Detecting psychopathy from thin slices of behavior. *Psychological Assessment*, *21*(1), 68.

Frank, M. G., & Ekman, P. (1997). The ability to detect deceit generalizes across different types of high-stake lies. *Journal of Personality and Social Psychology*, *72*(6), 1429.

Frank, M. G., & Ekman, P. (2004). Nonverbal detection of deception in forensic contexts. *Handbook of Forensic Psychology*, 635–653.

Frank, M. G., Ekman, P., & Friesen, W. V. (1993). Behavioral markers and recognizability of the smile of enjoyment. *Journal of Personality and Social Psychology*, *64*(1), 83.

Frank, M. G., & Feeley, T. H. (2003). To catch a liar: Challenges for research in lie detection training. *Journal of Applied Communication Research*, *31*(1), 58–75.

Frank, M. G., Feeley, T. H., Paolantonio, N., & Servoss, T. J. (2004). Individual and small group accuracy in judging truthful and deceptive communication. *Group Decision and Negotiation*, *13*(1), 45–59.

Frank, M. G., Matsumoto, D., Ekman, P., Kang, S., & Kurylo, A. (2008). Improving the ability to recognize micro expressions of emotion. *Manuscript under Review*.

Frank, M. G., & Svetieva, E. (2012). Lies worth catching involve both emotion and cognition. *Journal of Applied Research in Memory and Cognition*, *1*(2), 131–133.

Franz, V. H., & von Luxburg, U. (2015). No Evidence for Unconscious Lie Detection A Significant Difference Does Not Imply Accurate Classification. *Psychological Science*, *26*(10):1646-8.

Frick, R. W. (1986). The prosodic expression of anger: Differentiating threat and frustration. *Aggressive Behavior*, *12*(2), 121–128.

Fridlund, A. J., Ekman, P., & Oster, H. (1987). Facial expressions of emotion. In Siegman, A. W & Feldstein, S. (Eds.), *Nonverbal behavior and communication* (2nd ed., pp. 143–224). NJ: Lawrence Erlbaum Associates.

Fulcher, J. S. (1942). " Voluntary" facial expression in blind and seeing children. *Archives of Psychology (Columbia University)*.

Funk, F., & Todorov, A. (2013). Criminal stereotypes in the courtroom: Facial tattoos affect guilt and punishment differently. *Psychology, Public Policy, and Law*, *19*(4), 466–478.

Fusaroli, R., Bahrami, B., Olsen, K., Roepstorff, A., Rees, G., Frith, C., & Tylén, K. (2012). Coming to terms quantifying the benefits of linguistic coordination. *Psychological Science*, *23*(8), 931-9

Fusaroli, R., & Tylén, K. (2016). Investigating conversational dynamics: Interactive alignment, Interpersonal synergy, and collective task performance. *Cognitive Science*, *40*(1), 145–171.

Fusar-Poli, P., Placentino, A., Carletti, F., Landi, P., & Abbamonte, M. (2009). Functional atlas of emotional faces processing: a voxel-based meta-analysis of 105 functional magnetic resonance imaging studies. *Journal of Psychiatry & Neuroscience: JPN*, *34*(6), 418.

Gallese, V. (2003). The roots of empathy: the shared manifold hypothesis and the neural basis of intersubjectivity. *Psychopathology*, *36*(4), 171–180.

Garrido, E., Masip, J., & Herrero, C. (2004). Police officers' credibility judgments: Accuracy and estimated ability. *International Journal of Psychology*, *39*(4), 254–275.

Gaspar, J. P., & Schweitzer, M. E. (2013). The emotion deception model: a review of deception in negotiation and the role of emotion in deception. *Negotiation and Conflict Management Research*, *6*(3), 160–179.

Gendron, M., Roberson, D., van der Vyver, J. M., & Barrett, L. F. (2014a). Cultural relativity in perceiving emotion from vocalizations. *Psychological Science*, *25*(4), 911–920.

Gendron, M., Roberson, D., van der Vyver, J. M., & Barrett, L. F. (2014b). Perceptions of emotion from facial expressions are not culturally universal: Evidence from a remote culture. *Emotion*, *14*(2), 251–262.

George, J. F., & Robb, A. (2008). Deception and computer-mediated communication in daily life. *Communication Reports*, *21*(2), 92–103.

George, J. F., Tilley, P., & Giordano, G. (2014). Sender credibility and deception detection. *Computers in Human Behavior*, *35*, 1–11.

Gery, I., Miljkovitch, R., Berthoz, S., & Soussignan, R. (2009). Empathy and recognition of facial expressions of emotion in sex offenders, non-sex offenders and normal controls. *Psychiatry Research*, *165*(3), 252–262.

Gigerenzer, G. (2008). *Rationality for mortals: How people cope with uncertainty*. Oxford University Press.

Gilbert, D. T., & Krull, D. S. (1988). Seeing less and knowing more: The benefits of perceptual ignorance. *Journal of Personality and Social Psychology*, *54*(2), 193.

Gilbert, D. T., Krull, D. S., & Malone, P. S. (1990). Unbelieving the unbelievable: Some problems in the rejection of false information. *Journal of Personality and Social Psychology*, *59*(4), 601.

Gilbert, D. T., & Malone, P. S. (1995). The correspondence bias. *Psychological Bulletin*, *117*(1), 21.

Gilbert, D. T., Pelham, B. W., & Krull, D. S. (1988). On cognitive busyness: When person perceivers meet persons perceived. *Journal of Personality and Social Psychology*, *54*(5), 733.

Gilovich, T., Savitsky, K., & Medvec, V. H. (1998). The illusion of transparency: biased assessments of others' ability to read one's emotional states. *Journal of Personality and Social Psychology*, *75*(2), 332.

Glass, S. J., & Newman, J. P. (2006). Recognition of facial affect in psychopathic offenders. *Journal of Abnormal Psychology*, *115*(4), 815.

Goldin-Meadow, S. (1993). When does gesture become language? A study of gesture used as a primary communication system by deaf children of hearing parents. *Tools, Language and Cognition in Human Evolution*, 63–85.

Goldin-Meadow, S. (1999). The role of gesture in communication and thinking. *Trends in Cognitive Sciences*, *3*(11), 419–429.

Goldin-Meadow, S. (2006). Talking and thinking with our hands. *Current Directions in Psychological Science*, *15*(1), 34–39.

Gonzalez-Liencres, C., Shamay-Tsoory, S. G., & Brüne, M. (2013). Towards a neuroscience of empathy: ontogeny, phylogeny, brain mechanisms, context and psychopathology. *Neuroscience & Biobehavioral Reviews*, *37*(8), 1537–1548.

Gosselin, P., Beaupré, M., & Boissonneault, A. (2002). Perception of genuine and masking smiles in children and adults: Sensitivity to traces of anger. *The Journal of Genetic Psychology*, *163*(1), 58–71.

Gosselin, P., Perron, M., & Beaupré, M. (2010). The voluntary control of facial action units in adults. *Emotion*, *10*(2), 266.

Gosselin, P., Perron, M., Legault, M., & Campanella, P. (2002). Children's and adults' knowledge of the distinction between enjoyment and nonenjoyment smiles. *Journal of Nonverbal Behavior*, *26*(2), 83–108.

Graham, J. A., & Argyle, M. (1975). A cross-cultural study of the communication of extra-verbal meaning by gestures (1). *International Journal of Psychology*, *10*(1), 57–67.

Granhag, P. A. (2006). Rethinking implicit lie detection. *Journal of Credibility Assessment and Witness Psychology*, *7*, 180–190.

Granhag, P. A., & Strömwall, L. A. (2001). Deception Detection: Interrogators' and Observers' Decoding of Consecutive Statements. *The Journal of Psychology*, *135*(6), 603–620.

Granhag, P. A., & Strömwall, L. A. (2004). *The detection of deception in forensic contexts*. Cambridge University Press.

Granhag, P. A., Strömwall, L. A., & Hartwig, M. (2007). The SUE-technique: The way to interview to detect deception. *Forensic Update*, *88*, 25-29.

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

Gregg, A. P. (2007). When vying reveals lying: The timed antagonistic response alethiometer. *Applied Cognitive Psychology*, *21*(5), 621–647.

Gross, J. J. (1998). The emerging field of emotion regulation: an integrative review. *Review of General Psychology*, *2*(3), 271.

Gross, J. J., & Levenson, R. W. (1995). Emotion elicitation using films. *Cognition & Emotion*, *9*(1), 87–108.

Gudjonsson, G. H. (1992). *The psychology of interrogations, confessions and testimony.* John Wiley & Sons.

Gudjonsson, G. H. (2005). Fitness to be interviewed. In J. Payne-James, R. W. Byard, T. S. Corey, & C. Henderson (Eds.), *Encyclopedia of forensic and legal medicine(Vol* (Vol. 2, pp. 169–174). London: Elsevier.

Gunnery, S. D., Hall, J. A., & Ruben, M. A. (2013). The Deliberate Duchenne Smile: Individual Differences in Expressive Control. *Journal of Nonverbal Behavior*, *37*(1), 29–41.

Haig, D. (2014). Troubled sleep: Night waking, breastfeeding and parent–offspring conflict. *Evolution, Medicine, and Public Health*, *2014*(1), 32–39.

Halberstadt, A. G., & Hall, J. A. (1980). Who's getting the message? Children's nonverbal skill and their evaluation by teachers. *Developmental Psychology*, *16*(6), 564.

Hall, J. A. (1978). Gender effects in decoding nonverbal cues. *Psychological Bulletin*, *85*(4), 845.

Hall, J. A. (1979). Gender, gender roles and nonverbal communication skills. In R. Rosenthal (Ed.), *Skill in nonverbal communications: Individual differences* (pp. 58–72). Cambridge, MA: Oelgeschlager.

Hall, J. A. (1984). *Nonverbal sex differences: Communication accuracy and expressive style*. Baltimore: Johns Hopkins University Press.

Hall, J. A., Andrzejewski, S. A., & Yopchick, J. E. (2009). Psychosocial correlates of interpersonal sensitivity: A meta-analysis. *Journal of Nonverbal Behavior*, *33*(3), 149–180.

Hall, J. A., & Bernieri, F. J. (2001). *Interpersonal sensitivity: Theory and measurement*. Psychology Press.

Hall, J. A., & Matsumoto, D. (2004). Gender differences in judgments of multiple emotions from facial expressions. *Emotion*, *4*(2), 201.

Hancock, J. T. (2007). Digital deception. *Oxford Handbook of Internet Psychology*, 289–301.

Hancock, J. T., Thom-Santelli, J., & Ritchie, T. (2004). Deception and design: The impact of communication technology on lying behavior. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 129–134). ACM.

Hartwig, M. (2004). Police Officers' Lie Detection Accuracy: Interrogating Freely Versus Observing Video. *Police Quarterly*, *7*(4), 429–456.

Hartwig, M. (2011). Methods in deception detection research. In B. Rosenfeld & S. D. Penrod (Eds.), *Research methods in forensic psychology* (pp. 136–155). Hoboken, NJ: John Wiley & Sons Inc.

Hartwig, M., & Bond, C. F. (2011). Why do lie-catchers fail? A lens model meta-analysis of human lie judgments. *Psychological Bulletin*, *137*(4), 643–659.

Hartwig, M., & Bond, C. F. (2014). Lie Detection from Multiple Cues: A Meta-analysis: Lie detection from multiple cues. *Applied Cognitive Psychology*, *28*(5), 661–676.

Hartwig, M., Granhag, P. A., Strömwall, L. A., & Andersson, L. O. (2004). Suspicious Minds: Criminals' ability to Detect Deception. *Psychology, Crime and Law*, *10*(1), 83–95.

Hartwig, M., Granhag, P. A., Strömwall, L. A., & Kronkvist, O. (2006). Strategic use of evidence during police interviews: When training to detect deception works. *Law and Human Behavior*, *30*(5), 603–619.

Hartwig, M., Granhag, P. A., Strömwall, L. A., & Vrij, A. (2002). *Deception detection: Effects of conversational involvement and probing*. Univ.

Hasson, O. (2009). Emotional tears as biological signals. *Evolutionary Psychology*, *7*(3), 363-370.

Hastie, R., & Kameda, T. (2005). The robust beauty of majority rules in group decisions. *Psychological Review*, *112*(2), 494.

Hatfield, E., Cacioppo, J. T., & Rapson, R. L. (1994). Emotional contagion: Cambridge studies in emotion and social interaction. *Cambridge, UK: Cambridge University Press. Errors-in-Variables Regression Model When the Variances of the Measurement Errors Vary between the Observations. Statistics in Medicine*, *21*, 1089–1101.

Hauch, V., Sporer, S. L., Michael, S. W., & Meissner, C. A. (2014). Does training improve the detection of deception? A meta-analysis. *Communication Research*, *43*(3) 283-343.

Hauser, M. D. (1997). 5 Minding the behaviour of deception. *Machiavellian Intelligence II: Extensions and Evaluations*, *2*, 112.

Hecht, M. A., & LaFrance, M. (1998). License or obligation to smile: The effect of power and sex on amount and type of smiling. *Personality and Social Psychology Bulletin*, *24*, 1332–1342.

Heerey, E. A., & Crossley, H. M. (2013). Predictive and reactive mechanisms in smile reciprocity. *Psychological Science*, *24*(8), 1446-1455.

Heerey, E. A., & Velani, H. (2010). Implicit learning of social predictions. *Journal of Experimental Social Psychology*, *46*(3), 577–581.

Hess, U., Banse, R., & Kappas, A. (1995). The intensity of facial expression is determined by underlying affective state and social situation. *Journal of Personality and Social Psychology*, *69*(2), 280.

Hess, U., Blairy, S., & Kleck, R. E. (1997). The intensity of emotional facial expressions and decoding accuracy. *Journal of Nonverbal Behavior*, *21*(4), 241–257.

Hess, U., & Fischer, A. (2013). Emotional mimicry as social regulation. *Personality and Social Psychology Review*, *17*(2), 142–157.

Hess, U., & Kleck, R. E. (1990). Differentiating emotion elicited and deliberate emotional facial expressions. *European Journal of Social Psychology*, *20*(5), 369–385.

Hess, U., & Kleck, R. E. (1994). The cues decoders use in attempting to differentiate emotion-elicited and posed facial expressions. *European Journal of Social Psychology*, *24*(3), 367–381.

Hill, M. L., & Craig, K. D. (2004). Detecting deception in facial expressions of pain: accuracy and training. *The Clinical Journal of Pain*, *20*(6), 415–422.

Hillman, J., Vrij, A., & Mann, S. (2012). Um … they were wearing …: The effect of deception on specific hand gestures: Specific hand gestures and deception. *Legal and Criminological Psychology*, *17*(2), 336–345.

Hilton, J. L., Fein, S., & Miller, D. T. (1993). Suspicion and dispositional inference. *Personality and Social Psychology Bulletin*, *19*, 501–501.

Hirokawa, R., Ebert, L., & Hurst, A. (1996). Communication and group-decision making effectiveness, in Communication and Group Decision Making. *Sage Publications, Thousand Oaks, CA*.

Hoffman, L. R., & Maier, N. R. (1961). Quality and acceptance of problem solutions by members of homogeneous and heterogeneous groups. *The Journal of Abnormal and Social Psychology*, *62*(2), 401.

Hoffman, M. L. (2001). *Empathy and moral development: Implications for caring and justice*. Cambridge University Press.

Holm, H. J., & Kawagoe, T. (2010). Face-to-face lying – An experimental study in Sweden and Japan. *Journal of Economic Psychology*, *31*(3), 310–321.

Hull, S. L. (1985). *Strasberg's method as taught by Lorrie Hull: A practical guide for actors, teachers, and directors*. Ox Bow Pr.

Hurd, K., & Noller, P. (1988). Decoding deception: A look at the process. *Journal of Nonverbal Behavior*, *12*(3), 217–233.

Hurley, C. M. (2012). Do you see what I see? Learning to detect micro expressions of emotion. *Motivation and Emotion*, *36*(3), 371–381.

Hurley, C. M., Anker, A. E., Frank, M. G., Matsumoto, D., & Hwang, H. C. (2014). Background factors predicting accuracy and improvement in micro expression recognition. *Motivation and Emotion*, *38*(5), 700–714.

Hurley, C. M., & Frank, M. G. (2011). Executing Facial Control During Deception Situations. *Journal of Nonverbal Behavior*, *35*(2), 119–131.

Hurley, C. M., Griffin, D. J., & Stefanone, M. A. (2014). Who told you that? uncovering the source of believed cues to deception. *International Journal of Psychological Studies*, *6*(1), 19.

Hurst, M., & Oswald, M. (2012). Mechanisms underlying response bias in deception detection. *Psychology, Crime & Law*, *18*(8), 759–778.

Ickes, W. (1993). Empathic accuracy. *Journal of Personality*, *61*(4), 587–610.

Ickes, W., Stinson, L., Bissonnette, V., & Garcia, S. (1990). Naturalistic social cognition: Empathic accuracy in mixed-sex dyads. *Journal of Personality and Social Psychology*, *59*(4), 730.

Inbau, F. E., Reid, J. E., Buckley, J. P., & Jayne, B. C. (2001). *Criminal interrogation and* *confessions* (4th ed.). Gaithersberg, MD: Aspen.

Inbau, F. E., Reid, J. E., Buckley, J. P., & Jayne, B. C. (2011). *Criminal interrogation and confessions*. Jones & Bartlett Publishers.

Israel, S., Hart, E., & Winter, E. (2014). Oxytocin decreases accuracy in the perception of social deception. *Psychological Science*, *25*(1), 293–295.

Izard, C. E. (1971). *The face of emotion*. New York: Appleton-Century-Crofts.

Izard, C. E. (1994). Innate and universal facial expressions: evidence from developmental and cross-cultural research. *Psychological Bulletin, 115*(2):288-99.

Izard, C. E. (2007). Basic emotions, natural kinds, emotion schemas, and a new paradigm. *Perspectives on Psychological Science*, *2*(3), 260–280.

Izard, C. E., Hembree, E. A., & Huebner, R. R. (1987). Infants' emotion expressions to acute pain: Developmental change and stability of individual differences. *Developmental Psychology*, *23*(1), 105.

Jani, B. D., Blane, D. N., & Mercer, S. W. (2012). The role of empathy in therapy and the physician-patient relationship. *Forschende Komplementärmedizin/Research in Complementary Medicine*, *19*(5), 252–257.

Janis, I. L. (1972). V*ictims of groupthink: a psychological study of foreign-policy decisions and fiascoes.* Michigan University: Houghton Mifflin Company.

Jayne, B., Horvath, F., & Buckley, J. (1994). Differentiation of truthful and deceptive criminal suspects in behavior analysis interviews. *Journal of Forensic Science*, *39*(3), 793–807.

Jehn, K. A., & Bezrukova, K. (2004). A field study of group diversity, workgroup context, and performance. *Journal of Organizational Behavior*, *25*(6), 703–729.

Jehn, K. A., Northcraft, G. B., & Neale, M. A. (1999). Why differences make a difference: A field study of diversity, conflict and performance in workgroups. *Administrative Science Quarterly*, *44*(4), 741–763.

Johnston, L., Carter, J., & McLellan, T. (2011). Don't dwell on it: the impact of rumination on emotional sensitivity. *Journal of Social and Clinical Psychology*, *30*(5), 506.

Johnston, L., Miles, L., & Macrae, C. N. (2010). Why are you smiling at me? Social functions of enjoyment and non-enjoyment smiles. *British Journal of Social Psychology*, *49*(1), 107–127.

Jones, E. E. (1979). The rocky road from acts to dispositions. *American Psychologist*, *34*(2), 107.

Kahn, E. A. (1964). On facial expression. *Clinical Neurosurgery*, *12*, 9.

Kana, R. K., & Travers, B. G. (2012). Neural substrates of interpreting actions and emotions from body postures. *Social Cognitive and Affective Neuroscience*, *7*(4), 446–456.

Kanwisher, N. (2009). The use of fMRI in lie detection: what has been shown and what has not. In Bizzi, S. E. Hyman, M. E. Raichle, N. Kanwisher, E. A. Phelps, S. J. Morse, W. Sinnott-Armstrong, J. S. Rakoff and H. T. Greel (Ed.), *Using imaging to identify deceit: Scientific and ethical questions* (1st ed., pp. 7–13). Cambridge, MA: American Academy of Arts and Sciences.

Karau, S. J., & Williams, K. D. (1993). Social loafing: A meta-analytic review and theoretical integration. *Journal of Personality and Social Psychology*, *65*(4), 681.

Karniol, R., & Shomroni, D. (1999). What being empathic means: applying the transformation rule approach to individual differences in predicting the thoughts and feelings of prototypic and nonprototypic others. *European Journal of Social Psychology*, *29*(2–3), 147–160.

Kashy, D. A., & DePaulo, B. M. (1996). Who lies? *Journal of Personality and Social Psychology*, *70*(5), 1037.

Kassin, S. M. (2005). On the psychology of confessions: Does innocence put innocents at risk? *American Psychologist*, *60*(3), 215.

Kassin, S. M. (2012). Paradigm shift in the study of human lie-detection: Bridging the gap between science and practice. *Journal of Applied Research in Memory and Cognition*, *1*(2), 118–119.

Kassin, S. M., & Fong, C. T. (1999). " I'm innocent!": Effects of training on judgments of truth and deception in the interrogation room. *Law and Human Behavior*, *23*(5), 499.

Kassin, S. M., Goldstein, C. C., & Savitsky, K. (2003). Behavioral confirmation in the interrogation room: On the dangers of presuming guilt. *Law and Human Behavior*, *27*(2), 187.

Kassin, S. M., & Gudjonsson, G. H. (2004). The psychology of confessions a review of the literature and issues. *Psychological Science in the Public Interest*, *5*(2), 33–67.

Kassin, S. M., Leo, R. A., Meissner, C. A., Richman, K. D., Colwell, L. H., Leach, A.-M., & La Fon, D. (2007). Police interviewing and interrogation: A self-report survey of police practices and beliefs. *Law and Human Behavior*, *31*(4), 381–400.

Kassin, S. M., & Norwick, R. J. (2004). Why people waive their Miranda rights: The power of innocence. *Law and Human Behavior*, *28*(2), 211–221.

Keating, C. F., & Heltman, K. R. (1994). Dominance and deception in children and adults: Are leaders the best misleaders? *Personality and Social Psychology Bulletin*, *20*(3), 312–321.

Kelly, S. D., Barr, D. J., Church, R. B., & Lynch, K. (1999). Offering a hand to pragmatic understanding: The role of speech and gesture in comprehension and memory. *Journal of Memory and Language*, *40*(4), 577–592.

Keltner, D., Gruenfeld, D. H., & Anderson, C. (2003). Power, approach, and inhibition. *Psychological Review*, *110*(2), 265.

Kendon, A. (1980). Gesticulation and speech: Two aspects of the process of utterance. *The Relationship of Verbal and Nonverbal Communication*, *25*(1980), 207–227.

Kendon, A. (1994). Do gestures communicate? A review. *Research on Language and Social Interaction*, *27*(3), 175–200.

Kendon, A. (2004). *Gesture: Visible action as utterance*. Cambridge University Press.

Kerr, N. L., & Tindale, R. S. (2004). Group performance and decision making. *Annu. Rev. Psychol.*, *55*, 623–655.

Keysers, C. (2012). The Empathic Brain. *Frontiers in Human Neuroscience*. *1.*

Keysers, C., & Gazzola, V. (2009). Expanding the mirror: vicarious activity for actions, emotions, and sensations. *Current Opinion in Neurobiology*, *19*(6), 666–671.

Keysers, C., Wicker, B., Gazzola, V., Anton, J.-L., Fogassi, L., & Gallese, V. (2004). A touching sight: SII/PV activation during the observation and experience of touch. *Neuron*, *42*(2), 335–346.

Kim, R. K., & Levine, T. R. (2011). The Effect of Suspicion on Deception Detection Accuracy: Optimal Level or Opposing Effects? *Communication Reports*, *24*(2), 51–62.

Kirouac, G., & Dore, F. Y. (1985). Accuracy of the judgment of facial expression of emotions as a function of sex and level of education. *Journal of Nonverbal Behavior*, *9*(1), 3–7.

Klein, N., & Epley, N. (2015). Group discussion improves lie detection. *Proceedings of the National Academy of Sciences*, *112*(24), 7460–7465.

Knapp, M. L. (2006). Lying and Deception in Close Relationships. In A. L. Vangelisti & D. Perlman (Eds.), *The Cambridge Handbook of Personal Relationships* (pp. 517–532). Cambridge University Press.

Knapp, M. L., & Comadena, M. E. (1979). Telling it like it isn't: A review of theory and research on deceptive communications. *Human Communication Research*, *5*(3), 270–285.

Knapp, M. L., & Hall, J. A. (2010). *Nonverbal behavior in human communication*. Boston: Wadsworth/Cengage.

Knapp, M. L., Hart, R. P., & Dennis, H. S. (1974). An exploration of deception as a communication construct. *Human Communication Research*, *1*(1), 15–29.

Köhnken, G. (1989). Behavioral correlates of statement credibility: Theories, paradigms, and results. In *Criminal behavior and the justice system* (pp. 271–289). Springer.

Konrad, K. A., Lohse, T., & Qari, S. (2013). Deception Detection and the Role of Self-selection. CEPR Discussion Paper No. DP9384.

Koopmann-Holm, B., & Matsumoto, D. (2011). Values and display rules for specific emotions. *Journal of Cross-Cultural Psychology*, *42*(3), 355–371.

Korva, N., Porter, S., O'Connor, B. P., Shaw, J., & ten Brinke, L. M. (2013). Dangerous

Decisions: Influence of Juror Attitudes and Defendant Appearance on Legal Decision-Making. *Psychiatry, Psychology and Law*, *20*(3), 384–398.

Kosonogov, V., Titova, A., & Vorobyeva, E. (2015). Empathy, but not mimicry restriction, influences the recognition of change in emotional facial expressions. *The Quarterly Journal of Experimental Psychology*, *68*(10), 2106–2115.

Kraus, M. W., & Keltner, D. (2009). Signs of socioeconomic status a thin-slicing approach. *Psychological Science*, *20*(1), 99–106.

Krauss, R. M. (1981). Impression formation, impression management, and nonverbal behaviors. In E. T. Higgins, C. P. Herman & M. Zanna (Ed.), *Social cognition: The Ontario Symposium* (Vol. 1, pp. 323–341).

Krauss, R. M. (1998). Why do we gesture when we speak? *Current Directions in Psychological Science*, *7*(2), 54–60.

Kraut, R. (1980). Humans as lie detectors. *Journal of Communication*, *30*(4), 209–218.

Krebs, J. R., & Dawkins, R. (1984). Animal signals: mind-reading and manipulation. *Behavioural Ecology: An Evolutionary Approach*, *2*, 380–402.

Krumhuber, E. G., & Kappas, A. (2005). Moving smiles: The role of dynamic components for the perception of the genuineness of smiles. *Journal of Nonverbal Behavior*, *29*(1), 3–24.

Krumhuber, E. G., Likowski, K. U., & Weyers, P. (2014). Facial Mimicry of Spontaneous and Deliberate Duchenne and Non-Duchenne Smiles. *Journal of Nonverbal Behavior*, *38*(1), 1–11.

Krumhuber, E. G., & Manstead, A. S. R. (2009). Can Duchenne smiles be feigned? New evidence on felt and false smiles. *Emotion*, *9*(6), 807–820.

Krumhuber, E. G., & Scherer, K. R. (2011). Affect bursts: dynamic patterns of facial expression. *Emotion*, *11*(4), 825.

Lakin, J. L., & Chartrand, T. L. (2003). Using nonconscious behavioral mimicry to create affiliation and rapport. *Psychological Science*, *14*(4), 334–339.

Lakin, J. L., Jefferis, V. E., Cheng, C. M., & Chartrand, T. L. (2003). The chameleon effect as social glue: Evidence for the evolutionary significance of nonconscious mimicry. *Journal of Nonverbal Behavior*, *27*(3), 145–162.

Lambert, N. M., Mulder, S., & Fincham, F. (2014). Thin slices of infidelity: Determining whether observers can pick out cheaters from a video clip interaction and what tips them off: Thin slices of infidelity. *Personal Relationships*, *21*(4), 612–619.

Lambrecht, L., Kreifelts, B., & Wildgruber, D. (2014). Gender differences in emotion recognition: Impact of sensory modality and emotional category. *Cognition and Emotion*, *28*(3), 452–469.

Lancaster, G. L., Vrij, A., Hope, L., & Waller, B. (2013). Sorting the liars from the truth tellers: The benefits of asking unanticipated questions on lie detection. *Applied Cognitive Psychology*, *27*(1), 107–114.

Landström, S., Af Hjelmsäter, E. R., & Granhag, P. A. (2007). The camera perspective bias: a case study. *Journal of Investigative Psychology and Offender Profiling*, *4*(3), 199–208.

Langton, S. R., O'Malley, C., & Bruce, V. (1996). Actions speak no louder than words: Symmetrical cross-modal interference effects in the processing of verbal and gestural information. *Journal of Experimental Psychology: Human Perception and Performance*, *22*(6), 1357.

Lars Krokoszinski, & Daniela Hosser. (2016). Emotion regulation during deception: an EEG study of imprisoned fraudsters. *Journal of Criminal Psychology*, *6*(2), 76–88.

Latane, B., Williams, K., & Harkins, S. (1979). Many hands make light the work: The causes and consequences of social loafing. *Journal of Personality and Social Psychology*, *37*(6), 822.

Lazarus, R. S. (1991). Progress on a cognitive-motivational-relational theory of emotion. *American Psychologist*, *46*(8), 819.

Leach, A.-M., Lindsay, R. C. L., Koehler, R., Beaudry, J. L., Bala, N. C., Lee, K., & Talwar, V. (2009). The reliability of lie detection performance. *Law and Human Behavior*, *33*(1), 96–109.

Leal, S., & Vrij, A. (2008). Blinking during and after lying. *Journal of Nonverbal Behavior*, *32*(4), 187–194.

Lench, H. C., Bench, S. W., & Flores, S. A. (2013). Searching for evidence, not a war: Reply to Lindquist, Siegel, Quigley, and Barrett (2013).

Lench, H. C., Flores, S. A., & Bench, S. W. (2011). Discrete emotions predict changes in cognition, judgment, experience, behavior, and physiology: a meta-analysis of experimental emotion elicitations. *Psychological Bulletin*, *137*(5), 834.

Lenti, C., Lenti-Boero, D., & Giacobbe, A. (1999). Decoding of emotional expressions in children and adolescents. *Perceptual and Motor Skills*, *89*(3 Pt 1), 808–814.

Levenson, R. W. (2014). The autonomic nervous system and emotion. *Emotion Review*, *6*(2), 100–112.

Levine, T. R. (2007). *MSU trivia game interviews*. Unpublished video tapes, East-Lansing: Michigan State University.

Levine, T. R. (2010). A few transparent liars. *Communication Yearbook*, *34*, 40–61.

Levine, T. R. (2014a). Active deception detection. *Policy Insights from the Behavioral and Brain Sciences*, *1*(1), 122–128.

Levine, T. R. (2014b). Truth-Default Theory (TDT) A Theory of Human Deception and Deception Detection. *Journal of Language and Social Psychology*, *33*(4), 378–392.

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*(3), 188–194.

Levine, T. R., Anders, L. N., Banas, J., Baum, K. L., Endo, K., Hu, A. D., & Wong, N. C. (2000). Norms, expectations, and deception: A norm violation model of veracity judgments. *Communications Monographs*, *67*(2), 123–137.

Levine, T. R., Blair, J. P., & Clare, D. D. (2014). Diagnostic utility: Experimental demonstrations and replications of powerful question effects in high-stakes deception detection. *Human Communication Research*, *40*(2), 262–289.

Levine, T. R., & Bond, C. F. (2014). Direct and Indirect Measures of Lie Detection Tell the

Same Story A Reply to ten Brinke, Stimson, and Carney (2014). *Psychological Science*, *25*(10), 1960–1961.

Levine, T. R., Clare, D. D., Green, T., Serota, K. B., & Park, H. S. (2014). The effects of truth–lie base rate on interactive deception detection accuracy. *Human Communication Research*, *40*(3), 350–372.

Levine, T. R., Feeley, T. H., McCornack, S. A., Hughes, M., & Harms, C. M. (2005). Testing the effects of nonverbal behavior training on accuracy in deception detection with the inclusion of a bogus training control group. *Western Journal of Communication*, *69*(3), 203–217.

Levine, T. R., Kim, R. K., & Blair, J. P. (2010). (In) accuracy at detecting true and false confessions and denials: An initial test of a projected motive model of veracity judgments. *Human Communication Research*, *36*(1), 82–102.

Levine, T. R., Kim, R. K., Park, H. S., & Hughes, M. (2006). Deception detection accuracy is a predictable linear function of message veracity base-rate: A formal test of Park and Levine's probability model. *Communication Monographs*, *73*(3), 243–260.

Levine, T. R., & McCornack, S. A. (1991). The dark side of trust: Conceptualizing and measuring types of communicative suspicion. *Communication Quarterly*, *39*(4), 325–340.

Levine, T. R., & McCornack, S. A. (1992). Linking love and lies: A formal test of the McCornack and Parks model of deception detection. *Journal of Social and Personal Relationships*, *9*(1), 143–154.

Levine, T. R., & McCornack, S. A. (2001). Behavioral adaptation, confidence, and heuristic-based explanations of the probing effect. *Human Communication Research*, *27*(4), 471–502.

Levine, T. R., McCornack, S. A., & Aleman, C. G. (1998). Ask and you shall believe: Behavioral adaptation, confidence, and heu-ristic-based explanations of the probing effect. *Unpublished Manuscript, Department of Speech, University of Hawaii*.

Levine, T. R., Park, H. S., & McCornack, S. A. (1999). Accuracy in detecting truths and lies:

Documenting the “veracity effect.” *Communication Monographs*, *66*(2), 125–144.

Levine, T. R., Serota, K. B., & Shulman, H. C. (2010). The Impact of Lie to Me on Viewers' Actual Ability to Detect Deception. *Communication Research*, *37*(6), 847–856.

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*(3), 377–403.

Levine, T. R., Shaw, A. S., & Shulman, H. (2010). Assessing Deception Detection Accuracy with Dichotomous Truth–Lie Judgments and Continuous Scaling: Are People Really More Accurate When Honesty Is Scaled? *Communication Research Reports*, *27*(2), 112–122.

Lindquist, K. A., Siegel, E. H., Quigley, K. S., & Barrett, L. F. (2013). The hundred-year emotion war: are emotions natural kinds or psychological constructions? Comment on Lench, Flores, and Bench (2011).

Lindquist, K. A., Wager, T. D., Kober, H., Bliss-Moreau, E., & Barrett, L. F. (2012). The brain basis of emotion: a meta-analytic review. *Behavioral and Brain Sciences*, *35*(3), 121–143.

Lindskold, S., & Walters, P. S. (1983). Categories for acceptability of lies. *The Journal of Social Psychology*, *120*(1), 129–136.

Lippard, P. V. (1988). “Ask me no questions, I'll tell you no lies”;: Situational exigencies for interpersonal deception. *Western Journal of Communication (Includes Communication Reports)*, *52*(1), 91–103.

Little, A. C., & Perrett, D. I. (2007). Using composite images to assess accuracy in personality attribution to faces. *British Journal of Psychology*, *98*(1), 111–126.

Loftus, E. F. (2011). Intelligence gathering post-9/11. *American Psychologist*, *66*(6), 532.

Ludden, G. D., Schifferstein, H. N., & Hekkert, P. (2009). Visual–tactual incongruities in products as sources of surprise. *Empirical Studies of the Arts*, *27*(1), 61–87.

Lundqvist, L.-O., & Dimberg, U. (1995). Facial expressions are contagious. *Journal of*

*Psychophysiology*.

Machotka, P. (1965). Body movement as communication. *Dialogues: Behavioral Science Research*, *2*, 33–66.

Mack, K. (2001). Challenging assumptions about credibility. *Law Society Journal: The Official Journal of the Law Society of New South Wales*, *39*(10), 60.

Malone, B. E., & DePaulo, B. M. (2001). Measuring sensitivity to deception. In J. A. Hall and F. J. Bernieri (eds.), *Interpersonal sensitivity: theory and measurement* (pp. 103–24). Mahwah, NJ: Lawrence Erlbaum.

Mandal, M. K., & Ambady, N. (2004). Laterality of facial expressions of emotion: Universal and culture-specific influences. *Behavioural Neurology*, *15*(1, 2), 23–34.

Manera, V., Grandi, E., & Colle, L. (2013). Susceptibility to emotional contagion for negative emotions improves detection of smile authenticity. *Frontiers in Human Neuroscience*, *7*.

Mann, S., Vrij, A., & Bull, R. (2002). Suspects, lies, and videotape: An analysis of authentic high-stake liars. *Law and Human Behavior*, *26*(3), 365–376.

Mann, S., Vrij, A., & Bull, R. (2004). Detecting true lies: police officers' ability to detect suspects' lies. *Journal of Applied Psychology*, *89*(1), 137.

Manusov, V. (1990). An application of attribution principles to nonverbal behavior in romantic dyads. *Communications Monographs*, *57*(2), 104–118.

Marangoni, C. A. (1989). *The facilitative effect of feedback training on objectively assessed empathic accuracy in a clinically relevant context*. Unpublished doctoral thesis.

Marett, L. K., & George, J. F. (2004). Deception in the case of one sender and multiple receivers. *Group Decision and Negotiation*, *13*(1), 29–44.

Maringer, M., Krumhuber, E. G., Fischer, A. H., & Niedenthal, P. M. (2011). Beyond smile dynamics: mimicry and beliefs in judgments of smiles. *Emotion*, *11*(1), 181.

Marsh, A. A., & Blair, R. J. R. (2008). Deficits in facial affect recognition among antisocial populations: a meta-analysis. *Neuroscience & Biobehavioral Reviews*, *32*(3), 454–465.

Martin, R. A., Berry, G. E., Dobranski, T., Horne, M., & Dodgson, P. G. (1996). Emotion perception threshold: Individual differences in emotional sensitivity. *Journal of Research in Personality*, *30*(2), 290–305.

Masip, J., Alonso, H., Garrido, E., & Antón, C. (2005). Generalized Communicative Suspicion (GCS) Among Police Officers: Accounting for the Investigator Bias Effect1. *Journal of Applied Social Psychology*, *35*(5), 1046–1066.

Masip, J., Alonso, H., Garrido, E., & Barba, A. (2008). Police officers' suspicion and veracity judgments. In *Comunicación presentada en la 18th Conference of the European association of Psychology and Law, Maastricht, Holanda*.

Masip, J., Alonso, H., Garrido, E., & Herrero, C. (2009). Training to detect what? The biasing effects of training on veracity judgments. *Applied Cognitive Psychology*, *23*(9), 1282–1296.

Masip, J., Alonso, H., Herrero, C., & Garrido, E. (2016). Experienced and novice officers' generalized communication suspicion and veracity judgments. *Law and Human Behavior*, *40*(2), 169–181.

Masip, J., & Herrero, C. (2015). New approaches in deception detection I. Background and theoretical framework. *Papeles Del Psicólogo*, *36*(2), 83–95.

Matsumoto, D. (2002). Methodological requirements to test a possible in-group advantage in judging emotions across cultures: comment on Elfenbein and Ambady (2002) and evidence. *Psychological Bulletin, 128*(2), 236-42.

Matsumoto, D., Hwang, H. C., Skinner, L. G., & Frank, M. G. (2014). Positive Effects in Detecting Lies from Training to Recognize Behavioral Anomalies. *Journal of Police and Criminal Psychology*, *29*(1), 28–35.

Matsumoto, D., & Hwang, H. S. (2011). Evidence for training the ability to read microexpressions of emotion. *Motivation and Emotion*, *35*(2), 181–191.

Matsumoto, D., Keltner, D., Shiota, M., Frank, M. G., & OSullivan, M. (2008). Whats in a face? Facial expressions as signals of discrete emotions. In M. Lewis, J. M. Haviland & L. Feldman Barrett (Eds.), *Handbook of emotions* (pp. 211-234). New York:

Guilford Press.

Matsumoto, D., LeRoux, J., Wilson-Cohn, C., Raroque, J., Kooken, K., Ekman, P., … Yee, A. (2000). A new test to measure emotion recognition ability: Matsumoto and Ekman's Japanese and Caucasian Brief Affect Recognition Test (JACBART). *Journal of Nonverbal Behavior*, *24*(3), 179–209.

Matsumoto, D., Olide, A., & Willingham, B. (2009). Is There an Ingroup Advantage in Recognizing Spontaneously Expressed Emotions? *Journal of Nonverbal Behavior*, *33*(3), 181–191.

Matsumoto, D., & Willingham, B. (2009). Spontaneous facial expressions of emotion of congenitally and noncongenitally blind individuals. *Journal of Personality and Social Psychology*, *96*(1), 1–10.

Matsumoto, D., Yoo, S. H., Hirayama, S., & Petrova, G. (2005). Development and validation of a measure of display rule knowledge: the display rule assessment inventory. *Emotion*, *5*(1), 23.

Maurage, P., Lahaye, M., Grynberg, D., Jeanjean, A., Guettat, L., Verellen-Dumoulin, C., … Constant, E. (2016). Dissociating emotional and cognitive empathy in pre-clinical and clinical Huntington's disease. *Psychiatry Research*, *237*, 103–108.

McArthur, L. Z. (1980). Illusory Causation and Illusory Correlation Two Epistemological Accounts. *Personality and Social Psychology Bulletin*, *6*(4), 507–519.

McClure, E. B. (2000). A meta-analytic review of sex differences in facial expression processing and their development in infants, children, and adolescents. *Psychological Bulletin*, *126*(3), 424.

McClure, E. B., & Nowicki Jr, S. (2001). Associations between social anxiety and nonverbal processing skill in preadolescent boys and girls. *Journal of Nonverbal Behavior*, *25*(1), 3–19.

McCornack, S. A. (1997). The generation of deceptive messages: Laying the groundwork for a viable theory of interpersonal deception.

McCornack, S. A., & Levine, T. R. (1990a). When lies are uncovered: Emotional and relational outcomes of discovered deception. *Communications Monographs*, *57*(2), 119–138.

McCornack, S. A., & Levine, T. R. (1990b). When lovers become leery: The relationship between suspicion and accuracy in detecting deception. *Communications Monographs*, *57*(3), 219–230.

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*(4), 348–377.

McCornack, S. A., & Parks, M. R. (1986). Deception detection and relationship development: The other side of trust. *Annals of the International Communication Association*, *9*(1), 377–389.

Mcgovern, F. H., & Fitz-Hugh, G. S. (1956). Diseases of the facial nerve. *The Laryngoscope*, *66*(3), 187–236.

McHaney, R., George, J. F., & Gupta, M. (2015). An Exploration of Deception Detection Are Groups More Effective Than Individuals? *Communication Research*, *93*, 607-627.

McKeown, G., Sneddon, I., & Curran, W. (2015). Gender differences in the perceptions of genuine and simulated laughter and amused facial expressions. *Emotion Review*, *7*(1), 30–38.

McKimmie, B. M., Masser, B. M., & Bongiorno, R. (2014). Looking Shifty but Telling the Truth: The Effect of Witness Demeanour on Mock Jurors' Perceptions. *Psychiatry, Psychology and Law*, *21*(2), 297–310.

McLellan, T., Johnston, L., Dalrymple-Alford, J., & Porter, R. J. (2010). Sensitivity to genuine versus posed emotion specified in facial displays. *Cognition & Emotion*, *24*(8), 1277–1292.

McNeill, D. (1985). So you think gestures are nonverbal? *Psychological Review*, *92*(3), 350.

McNeill, D. (1992). *Hand and mind: What gestures reveal about thought*. University of Chicago press.

McNeill, D. (2005). Gesture, gaze, and ground. In *International Workshop on Machine Learning for Multimodal Interaction* (pp. 1–14). Springer.

McNeill, D., Cassell, J., & McCullough, K.-E. (1994). Communicative effects of speech-mismatched gestures. *Research on Language and Social Interaction*, *27*(3), 223–237.

Meeren, H. K., van Heijnsbergen, C. C., & de Gelder, B. (2005). Rapid perceptual integration of facial expression and emotional body language. *Proceedings of the National Academy of Sciences of the United States of America*, *102*(45), 16518–16523.

Mehrabian, A. (1969). Significance of posture and position in the communication of attitude and status relationships. *Psychological Bulletin*, *71*(5), 359.

Mehrabian, A. (1972). *Nonverbal communication*. Transaction Publishers.

Mehrabian, A., & Ferris, S. R. (1967). Inference of attitudes from nonverbal communication in two channels. *Journal of Consulting Psychology*, *31*(3), 248.

Mehrabian, A., & Friar, J. T. (1969). Encoding of attitude by a seated communicator via posture and position cues. *Journal of Consulting and Clinical Psychology*, *33*(3), 330.

Mehu, M., Mortillaro, M., Bänziger, T., & Scherer, K. R. (2012). Reliable facial muscle activation enhances recognizability and credibility of emotional expression. *Emotion*, *12*(4), 701–715.

Meissner, C. A., & Kassin, S. M. (2002). " He's guilty!": investigator bias in judgments of truth and deception. *Law and Human Behavior*, *26*(5), 469.

Mesquita, B. (2003). Emotions as dynamic cultural phenomena. In R. Davidson, K. Scherer, & H. Goldsmith (Eds.), *Handbook of Affective Sciences* (pp. 871–890).

Mestre, M. V., Samper, P., Frías, M. D., & Tur, A. M. (2009). Are women more empathetic than men? A longitudinal study in adolescence. *The Spanish Journal of Psychology*, *12*(1), 76–83.

Metts, S. (1989). An exploratory investigation of deception in close relationships. *Journal of*

*Social and Personal Relationships*, *6*(2), 159–179.

Miehlke, A., Fisch, U., & Eneroth, C.-M. (1973). *Surgery of the facial nerve*. Saunders.

Miles, L., & Johnston, L. (2007). Detecting happiness: Perceiver sensitivity to enjoyment and non-enjoyment smiles. *Journal of Nonverbal Behavior*, *31*(4), 259–275.

Millar, M. G., & Millar, K. U. (1997). The effects of cognitive capacity and suspicion on truth bias. *Communication Research*, *24*(5), 556–570.

Miller, G. R., & Stiff, J. B. (1993). *Deceptive communication.* Sage Publications, Inc.

Mistschenka, M. N. (1933). Ueber die mimische Gesichtsmotorik derBlinden [Facial mimicking motor behavior in blind individuals]. *Folida Neuropathologica Estoniana*, *13*, 24–43.

Miura, M. (1993). Individual differences in the perception of facial expression: the relation to sex difference and cognitive mode. *Shinrigaku Kenkyu: The Japanese Journal of Psychology*, *63*(6), 409–413.

Moi, W. Y., & Shanks, D. R. (2015). Can lies be detected unconsciously? *Frontiers in Psychology*, *6*.

Montagne, B., Kessels, R. P., Frigerio, E., de Haan, E. H., & Perrett, D. I. (2005). Sex differences in the perception of affective facial expressions: do men really lack emotional sensitivity? *Cognitive Processing*, *6*(2), 136–141.

Moran, S., & Schweitzer, M. E. (2008). When better is worse: Envy and the use of deception. *Negotiation and Conflict Management Research*, *1*(1), 3–29.

Motley, M. T., & Camden, C. T. (1988). Facial expression of emotion: A comparison of posed expressions versus spontaneous expressions in an interpersonal communication setting. *Western Journal of Speech Communication*, *52*(1), 1–22.

Murphy, F. C., Nimmo-Smith, I. A. N., & Lawrence, A. D. (2003). Functional neuroanatomy of emotions: a meta-analysis. *Cognitive, Affective, & Behavioral Neuroscience*, *3*(3), 207–233.

Myers, R. E. (1976). Comparative neurology of vocalization and speech: Proof of a dichotomy. *Annals of the New York Academy of Sciences*, *280*(1), 745–757.

Naab, P. J., & Russell, J. A. (2007). Judgments of emotion from spontaneous facial expressions of New Guineans. *Emotion*, *7*(4), 736.

Namba, S., Makihara, S., Kabir, R. S., Miyatani, M., & Nakao, T. (2016). Spontaneous Facial Expressions Are Different from Posed Facial Expressions: Morphological Properties and Dynamic Sequences. *Current Psychology*, 1–13.

Nelson, C. A., & de Haan, M. (1997). A neurobehavioral approach to the recognition of facial expressions in infancy. *The Psychology of Facial Expression*, 176–204.

Nelson, N. L., & Russell, J. A. (2013). Universality Revisited. *Emotion Review*, *5*(1), 8–15.

Nett, N., Bröder, A., & Frings, C. (2015). When irrelevance matters: Stimulus-response binding in decision making under uncertainty. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *41*(6), 1831.

Neufeld, J., & Chakrabarti, B. (2016). Empathy Modulates the Rewarding Effect of Mimicry. *Scientific Reports*, *6*.

Neumann, R., Förster, J., & Strack, F. (2003). Motor compatibility: The bidirectional link between behavior and evaluation. *The Psychology of Evaluation: Affective Processes in Cognition and Emotion*, 371–391.

Niedenthal, P. M., Barsalou, L. W., Ric, F., & Krauth-Gruber, S. (2005). Embodiment in the acquisition and use of emotion knowledge. In L. F. Barrett, P. M. Niedenthal, & P. Winkielman (Eds.), *Emotion: Conscious and unconscious* (pp. 21–50). New York: Guilford.

Niedenthal, P. M., Krauth-Gruber, S., & Ric, F. (2006). Psychology of emotion. *Interpersonal, Experiential, and Cognitive Approaches*. Principles of Social Psychology series. New York: Psychology Press.

Niedenthal, P. M., Mermillod, M., Maringer, M., & Hess, U. (2010). The Simulation of Smiles (SIMS) model: Embodied simulation and the meaning of facial expression. *Behavioral and Brain Sciences*, *33*(6), 417–433.

Nisbett, R., & Ross, L. (1991). The person and the situation. *NY: McGraw Hill*.

Noller, P. (1985). Video primacy—A further look. *Journal of Nonverbal Behavior*, *9*(1), 28–

47.

Noller, P. (2006). Nonverbal communication in close relationships. *The Sage Handbook of Nonverbal Communication*, 403–420.

Nowicki Jr, S., & Carton, E. (1997). The relation of nonverbal processing ability of faces and voices and children's feelings of depression and competence. *The Journal of Genetic Psychology*, *158*(3), 357–363.

Nowicki Jr, S., & Mitchell, J. (1998). Accuracy in identifying affect in child and adult faces and voices and social competence in preschool children. *Genetic, Social, and General Psychology Monographs*, *124*(1), 39–60.

Nowicki, S., & Duke, M. P. (1994). Individual differences in the nonverbal communication of affect: The Diagnostic Analysis of Nonverbal Accuracy Scale. *Journal of Nonverbal Behavior*, *18*(1), 9–35.

Oberman, L. M., Winkielman, P., & Ramachandran, V. S. (2007). Face to face: Blocking facial mimicry can selectively impair recognition of emotional expressions. *Social Neuroscience*, *2*(3–4), 167–178.

Öhman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: toward an evolved module of fear and fear learning. *Psychological Review*, *108*(3), 483.

Okubo, M., Kobayashi, A., & Ishikawa, K. (2012). A fake smile thwarts cheater detection. *Journal of Nonverbal Behavior*, *36*(3), 217–225.

Oliveira, C. M., & Levine, T. R. (2008). Lie acceptability: A construct and measure. *Communication Research Reports*, *25*(4), 282–288.

Ortony, A., & Turner, T. J. (1990). What's basic about basic emotions? *Psychological Review*, *97*(3), 315.

O'Sullivan, M. (2007). Unicorns or Tiger Woods: Are lie detection experts myths or rarities? A response to on lie detection "wizards" by Bond and Uysal. *Law and Human Behavior*, *31*(1), 117–123.

O'Sullivan, M., & Ekman, P. (2004). The wizards of deception detection. In P. A. Granhag & L. A. Strömwall (Eds.), *The detection of deception in forensic contexts* (pp. 269–

286). Cambridge, England: Cambridge University Press.

O'Sullivan, M., Frank, M. G., Hurley, C. M., & Tiwana, J. (2009). Police lie detection accuracy: The effect of lie scenario. *Law and Human Behavior*, *33*(6), 530–538.

Owren, M. J., & Bachorowski, J.-A. The evolution of emotional experience: A" selfish-gene" account of smiling and laughter in early hominids and humans. In Bonanno, George A. (Ed). (2001). Emotions: Current issues and future directions, (pp. 152-191). New York, NY: Guilford Press.

Owren, M. J., & Bachorowski, J.-A. (2003). Reconsidering the evolution of nonlinguistic communication: The case of laughter. *Journal of Nonverbal Behavior*, *27*(3), 183–200.

Owren, M. J., Rendall, D., & Bachorowski, J.-A. (2003). Nonlinguistic vocal communication. *Primate Psychology*, 359–394.

Panksepp, J. (1998). *Affective neuroscience: The foundations of human and animal emotions*. Oxford university press.

Park, E. S., Levine, T. R., Harms, C. M., & Ferrara, M. H. (2002). Group and individual accuracy in deception detection. *Communication Research Reports*, *19*(2), 99–106.

Park, H. S., Levine, T. R., McCornack, S., Morrison, K., & Ferrara, M. (2002). How people really detect lies. *Communication Monographs*, *69*(2), 144–157.

Paulus, P. B., Dzindolet, M. T., Poletes, G., & Camacho, L. M. (1993). Perception of performance in group brainstorming: The illusion of group productivity. *Personality and Social Psychology Bulletin*, *19*(1), 78–89.

Peace, K. A., & Sinclair, S. M. (2012). Cold-blooded lie catchers? An investigation of psychopathy, emotional processing, and deception detection. *Legal and Criminological Psychology*, *17*(1), 177–191.

Perron, M., Roy-Charland, A., Chamberland, J. A., Bleach, C., & Pelot, A. (2016). Differences between traces of negative emotions in smile judgment. *Motivation and Emotion*, 1–11.

Petrides, K. V., & Furnham, A. (2003). Trait emotional intelligence: Behavioural validation in two studies of emotion recognition and reactivity to mood induction. *European Journal of Personality*, *17*(1), 39–57.

Phan, K. L., Wager, T., Taylor, S. F., & Liberzon, I. (2002). Functional neuroanatomy of emotion: a meta-analysis of emotion activation studies in PET and fMRI. *Neuroimage*, *16*(2), 331–348.

Philippot, P., & Feldman, R. S. (1990). Age and social competence in preschoolers' decoding of facial expression. *British Journal of Social Psychology*, *29*(1), 43–54.

Platzer, C., & Bröder, A. (2012). Most people do not ignore salient invalid cues in memory-based decisions. *Psychonomic Bulletin & Review*, *19*(4), 654–661.

Porter, S., Juodis, M., ten Brinke, L. M., Klein, R., & Wilson, K. (2010). Evaluation of the effectiveness of a brief deception detection training program. *Journal of Forensic Psychiatry & Psychology*, *21*(1), 66–76.

Porter, S., Korva, N., & Baker, A. (2011). Secrets of the human face: new insights into the face and covert emotions. *Psychology Aotearoa*.

Porter, S., McCabe, S., Woodworth, M., & Peace, K. A. (2007). Genius is 1% inspiration and 99% perspiration… or is it? An investigation of the impact of motivation and feedback on deception detection. *Legal and Criminological Psychology*, *12*(2), 297–309.

Porter, S., & ten Brinke, L. M. (2008). Reading between the lies identifying concealed and falsified emotions in universal facial expressions. *Psychological Science*, *19*(5), 508–514.

Porter, S., & ten Brinke, L. M. (2009). Dangerous decisions: A theoretical framework for understanding how judges assess credibility in the courtroom. *Legal and Criminological Psychology*, *14*(1), 119–134.

Porter, S., & ten Brinke, L. M. (2010). The truth about lies: What works in detecting high-stakes deception? *Legal and Criminological Psychology*, *15*(1), 57–75.

Porter, S., ten Brinke, L. M., & Gustaw, C. (2010). Dangerous decisions: the impact of first impressions of trustworthiness on the evaluation of legal evidence and defendant culpability. *Psychology, Crime & Law*, *16*(6), 477–491.

Porter, S., ten Brinke, L. M., & Wallace, B. (2012). Secrets and Lies: Involuntary Leakage in Deceptive Facial Expressions as a Function of Emotional Intensity. *Journal of Nonverbal Behavior*, *36*(1), 23–37.

Porter, S., ten Brinke, L. M., & Wilson, K. (2009). Crime profiles and conditional release performance of psychopathic and non-psychopathic sexual offenders. *Legal and Criminological Psychology*, *14*(1), 109–118.

Posten, A.-C., & Mussweiler, T. (2013). When distrust frees your mind: The stereotype-reducing effects of distrust. *Journal of Personality and Social Psychology*, *105*(4), 567.

Price, T. F., & Harmon-Jones, E. (2010). The effect of embodied emotive states on cognitive categorization. *Emotion*, *10*(6), 934–938.

Priester, J. R., Cacioppo, J. T., & Petty, R. E. (1996). The influence of motor processes on attitudes toward novel versus familiar semantic stimuli. *Personality and Social Psychology Bulletin*, *22*, 442–447.

Prochnow, D., Höing, B., Kleiser, R., Lindenberg, R., Wittsack, H.-J., Schäfer, R., … Seitz, R. J. (2013). The neural correlates of affect reading: an fMRI study on faces and gestures. *Behavioural Brain Research*, *237*, 270–277.

Prochnow, D., Kossack, H., Brunheim, S., Müller, K., Wittsack, H.-J., Markowitsch, H.-J., & Seitz, R. J. (2013). Processing of subliminal facial expressions of emotion: A behavioral and fMRI study. *Social Neuroscience*, *8*(5), 448–461.

Proverbio, A., Matarazzo, S., Brignone, V., Zotto, M. D., & Zani, A. (2007). Processing valence and intensity of infant expressions: The roles of expertise and gender. *Scandinavian Journal of Psychology*, *48*(6), 477–485.

Provine, R. R. (1997). Yawns, laughs, smiles, tickles, and talking: Naturalistic and laboratory studies of facial action and social communication. *The Psychology of Facial Expression*, 158.

Raafat, R. M., Chater, N., & Frith, C. (2009). Herding in humans. *Trends in Cognitive*

*Sciences*, *13*(10), 420–428.

Rae, G. (1976). Table of A'. *Perceptual and Motor Skills*.

Rauscher, F. H., Krauss, R. M., & Chen, Y. (1996). Gesture, speech, and lexical access: The role of lexical movements in speech production. *Psychological Science*, *7*(4), 226–231.

Reisenzein, R. (2000). Exploring the Strength of Association between the Components of Emotion Syndromes: The Case of Surprise. *Cognition and Emotion*, *14*(1), 1–38.

Reisenzein, R., Bördgen, S., Holtbernd, T., & Matz, D. (2006). Evidence for strong dissociation between emotion and facial displays: The case of surprise. *Journal of Personality and Social Psychology*, *91*(2), 295–315.

Reisenzein, R., & Studtmann, M. (2007). On the expression and experience of surprise: No evidence for facial feedback, but evidence for a reverse self-inference effect. *Emotion*, *7*(3), 612–627.

Reniers, R. L., Corcoran, R., Drake, R., Shryane, N. M., & Völlm, B. A. (2011). The QCAE: A questionnaire of cognitive and affective empathy. *Journal of Personality Assessment*, *93*(1), 84–95.

Riggio, R. E., & Friedman, H. S. (1983). Individual differences and cues to deception. *Journal of Personality and Social Psychology*, *45*(4), 899.

Riggio, R. E., Salinas, C., & Tucker, J. (1988). Personality and deception ability. *Personality and Individual Differences*, *9*(1), 189–191.

Riggio, R. E., Tucker, J., & Throckmorton, B. (1987). Social skills and deception ability. *Personality and Social Psychology Bulletin*, *13*(4), 568–577.

Rinn, W. E. (1984). The neuropsychology of facial expression: a review of the neurological and psychological mechanisms for producing facial expressions. *Psychological Bulletin*, *95*(1), 52.

Rinn, W. E. (1991). Neuropsychology of facial expression.

Riskind, J. H. (1983). Nonverbal expressions and the accessibility of life experience memories: A congruence hypothesis. *Social Cognition*, *2*(1), 62–86.

Riskind, J. H., & Gotay, C. C. (1982). Physical posture: Could it have regulatory or feedback effects on motivation and emotion? *Motivation and Emotion*, *6*(3), 273–298.

Roberts, R. D., Schulze, R., O'Brien, K., MacCann, C., Reid, J., & Maul, A. (2006). Exploring the validity of the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) with established emotions measures. *Emotion*, *6*(4), 663.

Rogers, R., & Gillard, N. D. (2013). Assessment of malingering on psychological measures. In G. P. Koocher, J. C. Norcross, & B. A. Greene (Eds.), *Psychologists' desk reference* (3rd ed., pp. 36–40). New York, NY: Oxford University Press.

Rogers, R., Gillard, N. D., Wooley, C. N., & Kelsey, K. R. (2013). Cross-Validation of the PAI Negative Distortion Scale for Feigned Mental Disorders A Research Report. *Assessment*, *20*(1), 36–42.

Rosenthal, R. (1991). *Meta-analytic procedures for social research* (Vol. 6). Sage.

Rosenthal, R., & DePaulo, B. M. (1979). Sex differences in eavesdropping on nonverbal cues. *Journal of Personality and Social Psychology*, *37*(2), 273.

Rosenthal, R., Hall, J. A., DiMatteo, M. R., Rogers, P. L., & Archer, D. (1979). *Sensitivity to nonverbal cues: The PONS test*. Baltimore: Johns Hopkins University Press.

Ross, L. (1977). The intuitive psychologist and his shortcomings: Distortions in the attribution process. *Advances in Experimental Social Psychology*, *10*, 173–220.

Rossberg-Gempton, I., & Poole, G. D. (1993). The effect of open and closed postures on pleasant and unpleasant emotions. *The Arts in Psychotherapy*, *20*(1), 75–82.

Rotter, N. G., & Rotter, G. S. (1988). Sex differences in the encoding and decoding of negative facial emotions. *Journal of Nonverbal Behavior*, *12*(2), 139–148.

Ruedy, N. E., Moore, C., Gino, F., & Schweitzer, M. E. (2013). The cheater's high: The unexpected affective benefits of unethical behavior. *Journal of Personality and Social Psychology*, *105*(4), 531.

Russell, J. A. (1994). Is there universal recognition of emotion from facial expression? A review of the cross-cultural studies. *Psychological Bulletin*, *115*(1), 102–141.

Russell, J. A. (1995). Facial expressions of emotion: What lies beyond minimal universality?

*Psychological Bulletin*, *118*(3), 379.

Russell, J. A. (2003). Core affect and the psychological construction of emotion. *Psychological Review*, *110*(1), 145.

Russell, J. A., & Fernández-Dols, J. M. (1997). *The psychology of facial expression*. Cambridge university press.

Salas, E., Nichols, D. R., & Driskell, J. E. (2007). Testing three team training strategies in intact teams a meta-analysis. *Small Group Research*, *38*(4), 471–488.

Salekin, R. T., Kubak, F. A., & Lee, Z. (2008). Deception in children and adolescents.

Sauter, D. A., Eisner, F., Ekman, P., & Scott, S. K. (2010). Cross-cultural recognition of basic emotions through nonverbal emotional vocalizations. *Proceedings of the National Academy of Sciences*, *107*(6), 2408–2412.

Sawada, R., Sato, W., Kochiyama, T., Uono, S., Kubota, Y., Yoshimura, S., & Toichi, M. (2014). Sex Differences in the Rapid Detection of Emotional Facial Expressions. *PLoS ONE*, *9*(4), e94747.

Scherer, K. R., & Bänziger, T. (2010). On the use of actor portrayals in research on emotional expression. *Blueprint for Affective Computing: A Sourcebook*, 166–176.

Scherer, K. R., Johnstone, T., & Klasmeyer, G. (2003). Vocal expression of emotion. *Handbook of Affective Sciences*, 433–456.

Schmid, P. C., Mast, M. S., Bombari, D., Mast, F. W., & Lobmaier, J. S. (2011). How mood states affect information processing during facial emotion recognition: an eye tracking study. *Swiss Journal of Psychology*, *70*(4), 223-231.

Schmitt, N., Coyle, B. W., & Saari, B. B. (1977). Types of task information feedback in multiple-cue probability learning. *Organizational Behavior and Human Performance*, *18*(2), 316–328.

Schützwohl, A., & Reisenzein, R. (2012). Facial expressions in response to a highly surprising event exceeding the field of vision: a test of Darwin's theory of surprise. *Evolution and Human Behavior*, *33*(6), 657–664.

Schwarz, N. (1990). *Feelings as information: informational and motivational functions of* *affective states.* Guilford Press.

Schwarz, N., & Clore, G. L. (1996). Feelings and phenomenal experiences. *Social Psychology: Handbook of Basic Principles*, *2*, 385–407.

Schweitzer, M. E., & Gibson, D. E. (2008). Fairness, feelings, and ethical decision-making: Consequences of violating community standards of fairness. *Journal of Business Ethics*, *77*(3), 287–301.

Searcy, W. A., & Nowicki, S. (2005). *The evolution of animal communication: reliability and deception in signaling systems*. Princeton University Press.

Seitz, R. J., Schäfer, R., Scherfeld, D., Friederichs, S., Popp, K., Wittsack, H.-J., … Franz, M. (2008). Valuating other people's emotional face expression: a combined functional magnetic resonance imaging and electroencephalography study. *Neuroscience*, *152*(3), 713–722.

Serota, K. B., & Levine, T. R. (2014). A Few Prolific Liars Variation in the Prevalence of Lying. *Journal of Language and Social Psychology*, *34*(2), 138-157.

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*(1), 2–25.

Shariff, A. F., & Tracy, J. L. (2011). What Are Emotion Expressions For? *Current Directions in Psychological Science*, *20*(6), 395–399.

Shaw, D. J., Vrij, A., Leal, S., Mann, S., Hillman, J., Granhag, P. A., & Fisher, R. P. (2015). Mimicry and Investigative Interviewing: Using Deliberate Mimicry to Elicit Information and Cues to Deceit: Mimicry and investigative interviewing. *Journal of Investigative Psychology and Offender Profiling*, *12*(3), 217–230.

Shaw, J., Porter, S., & ten Brinke, L. M. (2013). Catching liars: training mental health and legal professionals to detect high-stakes lies. *The Journal of Forensic Psychiatry & Psychology*, *24*(2), 145–159.

Shawyer, A., & Milne, R. (2015). PEACE in fraud interviews: Assumptions and detection of guilt and the impact on interviewer behaviour. *Crime Prevention & Community Safety*, *17*(1), 30–46.

Shepherd, E., & Griffiths, A. (2013). *Investigative interviewing: The conversation management approach* (2nd ed.). Oxford, Untied Kingdom: Oxford University Press.

Sigall, H., & Ostrove, N. (1975). Beautiful but dangerous: Effects of offender attractiveness and nature of the crime on juridic judgment. *Journal of Personality and Social Psychology*, *31*(3), 410–414.

Sim, M. P. Y., & Lamb, M. E. (2012). Police perceptions of interviews with juvenile suspects. In *Annual Conference of the American Psychology-Law Society, Puerto Rico* (pp. 14–17).

Singer, T. (2006). The neuronal basis and ontogeny of empathy and mind reading: review of literature and implications for future research. *Neuroscience & Biobehavioral Reviews*, *30*(6), 855–863.

Sip, K. E., Carmel, D., Marchant, J. L., Li, J., Petrovic, P., Roepstorff, A., … Frith, C. D. (2012). When Pinocchio's nose does not grow: belief regarding lie-detectability modulates production of deception. *Frontiers in Human Neuroscience, 4*(7), 16.

Sip, K. E., Lynge, M., Wallentin, M., McGregor, W. B., Frith, C. D., & Roepstorff, A. (2010). The production and detection of deception in an interactive game. *Neuropsychologia*, *48*(12), 3619–3626.

Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology*, *48*(4), 813.

Smith, D. L. (2004). *Why we lie*. New York: St. Martin's Griffin.

Sniezek, J. A. (1992). Groups under uncertainty: An examination of confidence in group decision making. *Organizational Behavior and Human Decision Processes*, *52*(1), 124–155.

Sniezek, J. A., & Henry, R. A. (1989). Accuracy and confidence in group judgment. *Organizational Behavior and Human Decision Processes*, *43*(1), 1–28.

Sonnby–Borgström, M. (2002). Automatic mimicry reactions as related to differences in emotional empathy. *Scandinavian Journal of Psychology*, *43*(5), 433–443.

Soppe, H. J. (1988). Age differences in the decoding of affect authenticity and intensity. *Journal of Nonverbal Behavior*, *12*(2), 107–119.

Sorochinski, M., Hartwig, M., Osborne, J., Wilkins, E., Marsh, J., Kazakov, D., & Granhag, P. A. (2014). Interviewing to Detect Deception: When to Disclose the Evidence? *Journal of Police and Criminal Psychology*, *29*(2), 87–94.

Soufan, A. H. (2011). *The black banners: The inside story of 9/11 and the war against al-Qaeda*. WW Norton & Company.

Sporer, S. L. (2016). Deception and Cognitive Load: Expanding Our Horizon with a Working Memory Model. *Frontiers in Psychology*, *7*.

Sporer, S. L., & Schwandt, B. (2007). Moderators of nonverbal indicators of deception: A meta-analytic synthesis. *Psychology, Public Policy, and Law*, *13*(1), 1–34.

Stathopoulou, I.-O., & Tsihrintzis, G. A. (2011). Emotion recognition from body movements and gestures. In *Intelligent Interactive Multimedia Systems and Services* (pp. 295–303). Springer.

Stel, M., Van Baaren, R. B., & Vonk, R. (2008). Effects of mimicking: Acting prosocially by being emotionally moved. *European Journal of Social Psychology*, *38*(6), 965–976.

Stel, M., van Dijk, E., & Olivier, E. (2009). You want to know the truth? Then don't mimic! *Psychological Science*, *20*(6), 693–699.

Stel, M., & van Knippenberg, A. (2008). The role of facial mimicry in the recognition of affect. *Psychological Science*, *19*(10), 984–985.

Stel, M., & Vonk, R. (2009). Empathizing via mimicry depends on whether emotional expressions are seen as real. *European Psychologist*, *14*(4), 342–350.

Stepper, S., & Strack, F. (1993). Proprioceptive determinants of emotional and nonemotional feelings. *Journal of Personality and Social Psychology*, *64*(2), 211.

Stiff, J. B., Kim, H. J., & Ramesh, C. N. (1992). Truth biases and aroused suspicion in relational deception. *Communication Research*, *19*(3), 326–345.

Stiff, J. B., & Miller, G. R. (1986). Come to think of it…. *Human Communication Research*, *12*(3), 339–357.

Stiff, J. B., Miller, G. R., Sleight, C., Mongeau, P., Garlick, R., & Rogan, R. (1989). Explanations for visual cue primacy in judgments of honesty and deceit. *Journal of Personality and Social Psychology*, *56*(4), 555.

Stillman, T. F., Maner, J. K., & Baumeister, R. F. (2010). A thin slice of violence: Distinguishing violent from nonviolent sex offenders at a glance. *Evolution and Human Behavior*, *31*(4), 298–303.

Strack, F., Martin, L. L., & Stepper, S. (1988). Inhibiting and facilitating conditions of the human smile: a nonobtrusive test of the facial feedback hypothesis. *Journal of Personality and Social Psychology*, *54*(5), 768.

Street, C. N. (2015). ALIED: Humans as adaptive lie detectors. *Journal of Applied Research in Memory and Cognition*, *4*(4), 335–343.

Street, C. N., & Richardson, D. C. (2015). The focal account: Indirect lie detection need not access unconscious, implicit knowledge. *Journal of Experimental Psychology: Applied*, *21*(4), 342.

Street, C. N., Tbaily, L., Baron, S., Khalil-Marzouk, P., Hanby, B., Wright, K., & Richardson, D. C. (2011). Bloomsbury deception set. In *British Psychological Society Division of Forensic Psychology Conference*.

Street, R. L., Wiemann, J. M., & Mulac, A. (1988). Speech evaluation differences as a function of perspective (participant versus observer) and presentational medium. *Human Communication Research*, *14*(3), 333–363.

Strömwall, L. A., & Granhag, P. A. (2003). How to detect deception? Arresting the beliefs of police officers, prosecutors and judges. *Psychology, Crime and Law*, *9*(1), 19–36.

Strömwall, L. A., Granhag, P. A., & Hartwig, M. (2004). *Practitioners' beliefs about deception.* Cambridge University Press.

Strömwall, L. A., Hartwig, M., & Granhag, P. A. (2006). To act truthfully: Nonverbal behaviour and strategies during a police interrogation. *Psychology, Crime & Law*, *12*(2), 207–219.

Su, L., & Levine, M. (2016). Does "lie to me" lie to you? An evaluation of facial clues to high-stakes deception. *Spontaneous Facial Behaviour Analysis*, *147*, 52–68.

Sud, P. (2011). Gender Differences in Nonverbal, Interpersonal Sensitivity Across Three Cultures: Japan, India, and the United States. *Comparative Culture, the Journal of Miyazaki International College*, *16*, 34–51.

Sun, S.-Y., Mai, X., Liu, C., Liu, J.-Y., & Luo, Y.-J. (2011). The processes leading to deception: ERP spatiotemporal principal component analysis and source analysis. *Social Neuroscience*, *6*(4), 348–359.

Svetieva, E., & Frank, M. G. (2016). Empathy, emotion dysregulation, and enhanced microexpression recognition ability. *Motivation and Emotion*, *40*(2), 309–320.

Talwar, V., & Lee, K. (2008). Social and cognitive correlates of children's lying behavior. *Child Development*, *79*(4), 866–881.

Tcherkassof, A., Bollon, T., Dubois, M., Pansu, P., & Adam, J.-M. (2007). Facial expressions of emotions: A methodological contribution to the study of spontaneous and dynamic emotional faces. *European Journal of Social Psychology*, *37*(6), 1325–1345.

ten Brinke, L. M., Khambatta, P., & Carney, D. R. (2015). Physically scarce (vs. enriched) environments decrease the ability to tell lies successfully. *Journal of Experimental Psychology: General*, *144*(5), 982–992.

ten Brinke, L. M., & Porter, S. (2012). Cry me a river: identifying the behavioral consequences of extremely high-stakes interpersonal deception. *Law and Human Behavior*, *36*(6), 469–477.

ten Brinke, L. M., Porter, S., & Baker, A. (2012). Darwin the detective: Observable facial muscle contractions reveal emotional high-stakes lies. *Evolution and Human Behavior*, *33*(4), 411–416.

ten Brinke, L. M., Stimson, D., & Carney, D. R. (2014). Some evidence for unconscious lie detection. *Psychological Science*, 956797614524421.

Ten Brinke, L., MacDonald, S., Porter, S., & O'Connor, B. (2012). Crocodile tears: facial, verbal and body language behaviours associated with genuine and fabricated remorse. *Law and Human Behavior*, *36*(1), 51.

The Global Deception Research Team. (2006). A World of Lies. *Journal of Cross-Cultural Psychology*, *37*(1), 60–74.

Theocharopoulou, F., Cocks, N., Pring, T., & Dipper, L. T. (2015). TOT phenomena: Gesture production in younger and older adults. *Psychology and Aging*, *30*(2), 245.

Thompson, L. A., & Massaro, D. W. (1986). Evaluation and integration of speech and pointing gestures during referential understanding. *Journal of Experimental Child Psychology*, *42*(1), 144–168.

Tiedens, L. Z., & Fragale, A. R. (2003). Power moves: complementarity in dominant and submissive nonverbal behavior. *Journal of Personality and Social Psychology*, *84*(3), 558.

Tindale, R. S. (1989). Group vs individual information processing: The effects of outcome feedback on decision making. *Organizational Behavior and Human Decision Processes*, *44*(3), 454–473.

Tobin, A., Favelle, S., & Palermo, R. (2016). Dynamic facial expressions are processed holistically, but not more holistically than static facial expressions. *Cognition and Emotion*, *30*(6), 1208–1221.

Todorov, A., Mandisodza, A. N., Goren, A., & Hall, C. C. (2005). Inferences of competence from faces predict election outcomes. *Science*, *308*(5728), 1623–1626.

Tom, G., Tong, S. T., & Hesse, C. (2010). Thick slice and thin slice teaching evaluations. *Social Psychology of Education*, *13*(1), 129–136.

Tomkins, S. (1963). Affect/imagery/consciousness. Vol. 2: The negative affects.

Tomkins, S. S. (1962). *Affect imagery consciousness: Volume I: The positive affects* (Vol. 1). Springer publishing company.

Toris, C., & DePaulo, B. M. (1984). Effects of actual deception and suspiciousness of deception on interpersonal perceptions. *Journal of Personality and Social Psychology*, *47*(5), 1063.

Tracy, J. L., & Matsumoto, D. (2008). The spontaneous expression of pride and shame:

Evidence for biologically innate nonverbal displays. *Proceedings of the National Academy of Sciences*, *105*(33), 11655–11660.

Tracy, J. L., & Randles, D. (2011). Four Models of Basic Emotions: A Review of Ekman and Cordaro, Izard, Levenson, and Panksepp and Watt. *Emotion Review*, *3*(4), 397–405.

Tracy, J. L., & Robins, R. W. (2008). The automaticity of emotion recognition. *Emotion*, *8*(1), 81.

Tschiassny, K. (1953). Eight Syndromes of Facial Paralysis and Their Significance in Locating the Lesion. *Annals of Otology, Rhinology & Laryngology*, *62*(3), 677–691.

Turner, M. E., & Pratkanis, A. R. (1998). Twenty-five years of groupthink theory and research: Lessons from the evaluation of a theory. *Organizational Behavior and Human Decision Processes*, *73*(2), 105–115.

Turner, R. E., Edgley, C., & Olmstead, G. (1975). Information control in conversations: Honesty is not always the best policy. *Kansas Journal of Sociology*, 69–89.

Van Der Zee, S., Poppe, R., Taylor, P. J., & Anderson, R. (2015). To freeze or not to freeze: A motion-capture approach to detecting deceit. In *Proceedings of the Hawaii International Conference on System Sciences, Kauai, HI*.

Vanhamme, J. (2000). The link between surprise and satisfaction: an exploratory research on how best to measure surprise. *Journal of Marketing Management*, *16*(6), 565–582.

Varinsky, H. (1992). Non-Verbal Communication Enhances Witness Credibility. *For The Defense, DRI*, 28–31.

Vaskinn, A., Sundet, K., Friis, S., Simonsen, C., Birkenaes, A. B., Engh, J. A., … Andreassen, O. A. (2007). The effect of gender on emotion perception in schizophrenia and bipolar disorder. *Acta Psychiatrica Scandinavica*, *116*(4), 263–270.

Vellante, M., Baron-Cohen, S., Melis, M., Marrone, M., Petretto, D. R., Masala, C., & Preti, A. (2013). The “Reading the Mind in the Eyes” test: systematic review of psychometric properties and a validation study in Italy. *Cognitive Neuropsychiatry*, *18*(4), 326–354.

Verschuere, B., Meijer, E., & Vrij, A. (2016). Increasing pressure does not benefit lie detection: a reply to Ten Brinke et al. (2015). *Psychology, Crime & Law*, 1–6.

Verschuere, B., Spruyt, A., Meijer, E. H., & Otgaar, H. (2011). The ease of lying. *Consciousness and Cognition*, *20*(3), 908–911.

Victoroff, J. (2005). The mind of the terrorist A review and critique of psychological approaches. *Journal of Conflict Resolution*, *49*(1), 3–42.

Vrij, A. (2000). *Detecting lies and deceit: The psychology of lying and implications for professional practice*. Wiley. Press.

Vrij, A. (2006). Detecting deception. *Practical Psychology for Forensic Investigations and Prosecutions: Wiley Series in Psychology of Crime, Policing, and Law. Chichester: Wiley & Sons*, 89–102.

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

Vrij, A. (2008). *Detecting lies and deceit: pitfalls and opportunities* (2. ed). Chichester: Wiley.

Vrij, A. (2015). A cognitive approach to lie detection. *Deception Detection: Current Challenges and New Approaches*, 205–229.

Vrij, A., Akehurst, L., & Morris, P. (1997). Individual differences in hand movements during deception. *Journal of Nonverbal Behavior*, *21*(2), 87–102.

Vrij, A., Akehurst, L., Soukara, S., & Bull, R. (2004). Detecting deceit via analyses of verbal and nonverbal behavior in children and adults. *Human Communication Research*, *30*(1), 8–41.

Vrij, A., Fisher, R., Mann, S., & Leal, S. (2006). Detecting deception by manipulating cognitive load. *Trends in Cognitive Sciences*, *10*(4), 141–142.

Vrij, A., & Graham, S. (1997). Individual differences between liars and the ability to detect lies. *Expert Evidence*, *5*(4), 144–148.

Vrij, A., & Granhag, P. A. (2012). The sound of critics: New tunes, old tunes, and resistance to play. *Journal of Applied Research in Memory and Cognition*, *1*(2), 139–143.

Vrij, A., Granhag, P. A., & Mann, S. (2010). Good liars. *The Journal of Psychiatry & Law*, *38*(1–2), 77–98.

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*(1), 28–32.

Vrij, A., Granhag, P. A., & Porter, S. (2010). Pitfalls and opportunities in nonverbal and verbal lie detection. *Psychological Science in the Public Interest*, *11*(3), 89–121.

Vrij, A., Harden, F., Terry, J., Edward, K., & Bull, R. (2001). The influence of personal characteristics, stakes and lie complexity on the accuracy and confidence to detect deceit.

Vrij, A., Mann, S. A., Fisher, R. P., Leal, S., Milne, R., & Bull, R. (2008). Increasing cognitive load to facilitate lie detection: The benefit of recalling an event in reverse order. *Law and Human Behavior*, *32*(3), 253–265.

Vrij, A., Mann, S., & Fisher, R. P. (2006a). An empirical test of the behaviour analysis interview. *Law and Human Behavior*, *30*(3), 329–345.

Vrij, A., Mann, S., & Fisher, R. P. (2006b). Information-gathering vs accusatory interview style: Individual differences in respondents' experiences. *Personality and Individual Differences*, *41*(4), 589–599.

Vrij, A., Mann, S., Kristen, S., & Fisher, R. P. (2007). Cues to deception and ability to detect lies as a function of police interview styles. *Law and Human Behavior*, *31*(5), 499–518.

Vrij, A., Mann, S., Robbins, E., & Robinson, M. (2006). Police officers ability to detect deception in high stakes situations and in repeated lie detection tests. *Applied Cognitive Psychology*, *20*(6), 741–755.

Vrij, A., Meissner, C. A., & Kassin, S. M. (2015). Problems in expert deception detection and the risk of false confessions: no proof to the contrary in Levine et al. (2014).

*Psychology, Crime & Law*, *21*(9), 901–909.

Vrij, A., & Semin, G. R. (1996). Lie experts' beliefs about nonverbal indicators of deception. *Journal of Nonverbal Behavior*, *20*(1), 65–80.

Vuilleumier, P., Armony, J. L., Driver, J., & Dolan, R. J. (2001). Effects of attention and emotion on face processing in the human brain: an event-related fMRI study. *Neuron*, *30*(3), 829–841.

Vytal, K., & Hamann, S. (2010). Neuroimaging support for discrete neural correlates of basic emotions: a voxel-based meta-analysis. *Journal of Cognitive Neuroscience*, *22*(12), 2864–2885.

Walden, T. A., & Field, T. M. (1982). Discrimination of facial expressions by preschool children. *Child Development*, 1312–1319.

Walker-Andrews, A. S. (1997). Infants' perception of expressive behaviors: differentiation of multimodal information. *Psychological Bulletin*, *121*(3), 437.

Warmelink, L., Vrij, A., Mann, S., Leal, S., & Poletiek, F. H. (2013). The effects of unexpected questions on detecting familiar and unfamiliar lies. *Psychiatry, Psychology and Law*, *20*(1), 29–35.

Warren, G., Schertler, E., & Bull, P. (2009). Detecting Deception from Emotional and Unemotional Cues. *Journal of Nonverbal Behavior*, *33*(1), 59–69.

Waskul, D. (2009). The importance of insincerity and inauthenticity for self and society: Why honesty is not the best policy. *Authenticity in Culture, Self, and Society*, 51–64.

Watson, D., Wiese, D., Vaidya, J., & Tellegen, A. (1999). The two general activation systems of affect: Structural findings, evolutionary considerations, and psychobiological evidence. *Journal of Personality and Social Psychology*, *76*(5), 820.

Watt, D. F. (2005). Social bonds and the nature of empathy. *Journal of Consciousness Studies*, *12*(8–9), 185–209.

Webb, C. (1977). The use of myoelectric feedback in teaching facial expression to the blind. *Biofeedback and Self-Regulation*, *2*(2), 147–160.

Wehrle, T., Kaiser, S., Schmidt, S., & Scherer, K. R. (2000). Studying the dynamics of emotional expression using synthesized facial muscle movements. *Journal of Personality and Social Psychology*, *78*(1), 105.

Weinberger, S. (2010). Airport security: Intent to deceive? *Nature*, *465*(7297), 412–415.

Wells, G. L., & Petty, R. E. (1980). The effects of over head movements on persuasion: Compatibility and incompatibility of responses. *Basic and Applied Social Psychology*, *1*(3), 219–230.

Whalen, P. J., Kagan, J., Cook, R. G., Davis, F. C., Kim, H., Polis, S., … Maxwell, J. S. (2004). Human amygdala responsivity to masked fearful eye whites. *Science*, *306*(5704), 2061–2061.

Whalen, P. J., & Phelps, E. A. (2009). *The human amygdala*. Guilford Press.

Whalen, P. J., Rauch, S. L., Etcoff, N. L., McInerney, S. C., Lee, M. B., & Jenike, M. A. (1998). Masked presentations of emotional facial expressions modulate amygdala activity without explicit knowledge. *The Journal of Neuroscience*, *18*(1), 411–418.

Whalen, P. J., Shin, L. M., McInerney, S. C., Fischer, H., Wright, C. I., & Rauch, S. L. (2001). A functional MRI study of human amygdala responses to facial expressions of fear versus anger. *Emotion*, *1*(1), 70.

Wild, B., Erb, M., & Bartels, M. (2001). Are emotions contagious? Evoked emotions while viewing emotionally expressive faces: quality, quantity, time course and gender differences. *Psychiatry Research*, *102*(2), 109–124.

Williams, J. H. G., Nicolson, A. T. A., Clephan, K. J., Grauw, H. de, & Perrett, D. I. (2013). A Novel Method Testing the Ability to Imitate Composite Emotional Expressions Reveals an Association with Empathy. *PLoS ONE*, *8*(4), e61941.

Williams, L. M., Mathersul, D., Palmer, D. M., Gur, R. C., Gur, R. E., & Gordon, E. (2009). Explicit identification and implicit recognition of facial emotions: I. Age effects in males and females across 10 decades. *Journal of Clinical and Experimental Neuropsychology*, *31*(3), 257–277.

Williamson, T. M. (1993). From interrogation to investigative interviewing; strategic trends in police questioning. *Journal of Community & Applied Social Psychology*, *3*(2), 89–99.

Willis, J., & Todorov, A. (2006). First impressions making up your mind after a 100-ms exposure to a face. *Psychological Science*, *17*(7), 592–598.

Wilson, M. (2002). Six views of embodied cognition. *Psychonomic Bulletin & Review*, *9*(4), 625–636.

Wilson-Mendenhall, C. D., Barrett, L. F., & Barsalou, L. W. (2013). Neural Evidence That Human Emotions Share Core Affective Properties. *Psychological Science*, *24*(6), 947–956.

Wiseman, R., Watt, C., ten Brinke, L. M., Porter, S., Couper, S.-L., & Rankin, C. (2012). The eyes don't have it: lie detection and neuro-linguistic programming. *PloS One*, *7*(7), e40259.

Wispe, J. R., Knight, M., & Roberts, R. J. (1986). Lipid Peroxidation in Newborn Rabbits: Effects of Oxygen, Lipid Emulsion, and Vitamin E. *Pediatric Research*, *20*(6), 505–510.

Wojciechowski, J., Stolarski, M., & Matthews, G. (2014). Emotional Intelligence and Mismatching Expressive and Verbal Messages: A Contribution to Detection of Deception. *PLoS ONE*, *9*(3), e92570.

Wood, J. V., Saltzberg, J. A., & Goldsamt, L. A. (1990). Does affect induce self-focused attention? *Journal of Personality and Social Psychology*, *58*(5), 899.

Wu, C., & Wang, S. (2016). Posed and Spontaneous Expression Recognition Through Restricted Boltzmann Machine. In *International Conference on Multimedia Modeling* (pp. 127–137). Springer.

Xu, F., Bao, X., Fu, G., Talwar, V., & Lee, K. (2010). Lying and truth-telling in children: From concept to action. *Child Development*, *81*(2), 581–596.

Yan, W.-J., Wu, Q., Liang, J., Chen, Y.-H., & Fu, X. (2013). How Fast are the Leaked Facial Expressions: The Duration of Micro-Expressions. *Journal of Nonverbal Behavior*, *37*(4), 217–230.

Yildirim, E. A., KaŞar, M., Güdük, M., AteŞ, E., Küçükparlak, I., & Özalmete, E. O. (2011). Investigation of the reliability of the “reading the mind in the eyes test” in a turkish population. *Turkish J Psychiatry*, *22*.

Yin, L., Reuter, M., & Weber, B. (2016). Let the man choose what to do: Neural correlates of spontaneous lying and truth-telling. *Brain and Cognition*, *102*, 13–25.

Zahavi, A., & Zahavi, A. (1999). *The handicap principle: A missing piece of Darwin’s puzzle*. Oxford University Press.

Zajonc, R. B. (1965). *Social facilitation*. Research Center for Group Dynamics, Institute for Social Research, University of Michigan.

Zebrowitz, L. A., & McDonald, S. M. (1991). The impact of litigants’ baby-facedness and attractiveness on adjudications in small claims courts. *Law and Human Behavior*, *15*(6), 603–623.

Zhang, K., Frumkin, L. A., Stedmon, A., & Lawson, G. (2013). Deception in Context: Coding Nonverbal Cues, Situational Variables and Risk of Detection. *Journal of Police and Criminal Psychology*, *28*(2), 150–161.

Zhong, C.-B. (2011). The ethical dangers of deliberative decision making. *Administrative Science Quarterly*, *56*(1), 1–25.

Zhou, L., Sung, Y., & Zhang, D. (2013). Deception performance in online group negotiation and decision making: the effects of deception experience and deception skill. *Group Decision and Negotiation*, *22*(1), 153–172.

Zloteanu, M. (2015). The Role of Emotions in Detecting Deception. In Williams, E. & Sheeha, I (Eds.), *Deception: An Interdisciplinary Exploration* (pp. 203–217). Oxford: Inter-Disciplinary Press.

Zloteanu, M., Richardson, Daniel C., & Krumhuber, Eva. (in prep). Behavioural Markers of Genuine and Deceptive Expressions of Emotion.

Zuckerman, M., DePaulo, B. M., & Rosenthal, R. (1981). Verbal and nonverbal communication of deception. *Advances in Experimental Social Psychology*, *14*, 1–59.

Zuckerman, M., DePaulo, B. M., & Rosenthal, R. (1986). Humans as deceivers and lie detectors. *Nonverbal Communication in the Clinical Context*, 13–35.

Zuckerman, M., & Driver, R. E. (1985). Telling lies: Verbal and nonverbal correlates of deception. In A. W. Siegman & S. Feldstein (Eds.), *Multichannel integrations of nonverbal behavior* (pp. 129–147). Hillsdale NJ: Erlbaum.

Zuckerman, M., Koestner, R., & Driver, R. (1981). Beliefs about cues associated with deception. *Journal of Nonverbal Behavior*, *6*(2), 105–114.

Zuckerman, M., Lipets, M. S., Koivumaki, J. H., & Rosenthal, R. (1975). Encoding and decoding nonverbal cues of emotion. *Journal of Personality and Social Psychology*, *32*(6), 1068.

Zuckerman, M., Spiegel, N. H., DePaulo, B. M., & Rosenthal, R. (1982). Nonverbal strategies for decoding deception. *Journal of Nonverbal Behavior*, *6*(3), 171–187.