

The Effects of Cognitive Load and Lying Types on Deception Cues

by

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Abstract

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Over the last decade, inducing cognitive load has been introduced as a possible lie detection technique (Vrij, et al., 2006). Evidence suggests that lying is a cognitively taxing task; therefore, increasing a deceiver's cognitive demands should make lying even more difficult, and true deception cues should become apparent. The present study investigated various behavioural cues that occurred between individuals who lied by omission or falsification. Cognitive load was used to amplify deception cues within subjects on half of the interview questions. It was predicted that there would be differences between cues based on deception type. The findings in the present study have revealed a main effect of cognitive load and a main effect of lying type. There was no interaction effect between cognitive load and falsification. The individual deception cues that were responsible for the variance are identified and implications for deception detection research and law enforcement are discussed.

Keywords: Deception, deception cues, cognitive load, lying type.

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Table of Contents

Abstract	i
Introduction	1
Deception	2
Deception Stereotypes	4
<i>Complex nature of deception cues.</i>	6
<i>High-stake lies.</i>	9
Deception Cues	11
<i>Reliability of cues.</i>	12
<i>Accuracy of judgements</i>	14
Current State of Deception Detection	16
Emotional Leakage	17
Interview and Interrogation: Tools and Techniques	21
<i>Behavioural Analysis Interview</i>	21
<i>PEACE model interview and strategic questioning</i>	24
<i>Polygraph techniques</i>	25
Neural correlates of deception	29
<i>Electroencephalogram</i>	30
<i>Functional magnetic resonance imaging</i>	31
Cognitive Theory	35
Working Memory	36
Cognitive Load	37
Cognitive Theory and Deception	39
<i>Four-Factor Model</i>	39
<i>Preoccupation Model of Secrecy</i>	40
<i>Interpersonal deception theory & Self-preservation theory</i>	40
<i>Activation-Decision-Construction Model</i>	41
<i>Time-Based Resource Sharing Model</i>	43
Cognitive load interview	44
Eye Blinks: Possible Cue to Cognitive Load and Deception	47
Present Study	51

Study Design	53
<i>Design and variables</i>	53
<i>Hypotheses</i>	54
Method	55
Participants	56
Measures & Materials	56
<i>Study environment and apparatus</i>	56
<i>Video Stimulus</i>	56
<i>Video equipment and editing</i>	57
<i>Manipulation, confidence, and experience checks</i>	58
<i>Interview questions and interviewers</i>	58
<i>Video coding and coders</i>	59
Procedure	60
Results	62
Coding Reliability	63
Missing Data	63
Assumption Tests	63
Manipulation Check	64
Condition Checks and Perceived Task Difficulty	65
<i>Effects of interviewer</i>	65
<i>Comparisons by condition</i>	65
<i>Participant self-report on confidence, difficulty and motivation</i>	66
Countermeasures to Deceit	67
Symptoms of Nervousness	70
Main Analyses	72
Discussion	76
Effects of Cognitive Load	76
Effects of Deception Type and Falsification	79
Cognitive Load Induction Technique	81
Practical Implications	83
Limitations & Future Research	89

Conclusions	91
References	94
Appendix A.....	106
Appendix B	108
Appendix C	109
Appendix D.....	111
Appendix E	113
Appendix F.....	115
Appendix G.....	118
Appendix H.....	119

Introduction

Deception is a large part of daily interpersonal communication. The average person lies at least twice a day with varied motivations and outcomes (DePaulo, Kashy, Kirkendol, Wyer & Epstein, 1996). People often tell inconsequential lies to protect another person's feelings, or to comply with some social norm (e.g., claiming we are "doing well" when in fact they are not). Sometimes people are deceptive about their physical appearance or background in order to look more desirable to a potential mate or employer (for a sample of the literature see Zuckerman, DePaulo, & Rosenthal, 1981; Miller, Mongeau, & Sleight, 1986; DePaulo, 1992; Steinel, Utz & Koning, 2010)¹. Occasionally, people lie for self-oriented reasons, such as protection from some real or perceived consequence to a past or future action (Ekman, 2009; Steinel et al., 2010)². It seems counterintuitive to think we can trust any message we receive, if lying, in all its forms, is a large part of how we communicate. But we trust these messages because the majority of lies encountered daily are insignificant. In fact, these transgressions are often ignored or discarded because there is a certain social etiquette that comes with being told a trivial falsehood (DePaulo et al., 1996; Ekman, 2009). That is, it is a common prosocial practice to overlook a small lie rather than confront deceivers and possibly embarrass them or create conflict.

¹ The terms lie and deception are used interchangeably throughout this thesis.

² Deception can occur in many forms (e.g., changing physical appearance, altering physical surroundings, and during interpersonal communication); however, for the purpose of this thesis, lying and deception are defined as *a deliberate attempt to mislead*.

Some lies, however, are not insignificant. These lies are fabricated to cover up antisocial behaviours, or to deny involvement in antisocial activities (e.g., a lie of self-interest; Zuckerman et al., 1981). These lies are generally referred to as “high-stakes” and the motivation for this type of deception is usually to avoid punishment or consequences (Frank & Ekman, 1997). High-stakes deception situations involving criminal acts often require more formal and sophisticated lie detection techniques to help determine the truth. These techniques are often employed by law enforcement agencies, and other organizations that use interrogation tactics, to gain information. This study investigated deception and deception detection from a law enforcement perspective. The aim of the study was to further the knowledge in the area of deception detection in relation to cognitive processes, as well as to answer preliminary questions that may eventually enhance the deception detection techniques used in law enforcement interrogation and questioning situations.

Deception

There is a consensus in the literature that the two primary ways to lie are to omit information and to falsify information (i.e., lies of omission and commission; Zuckerman, et al., 1981; DePaulo, Lindsay, Malone, Muhlenbruck, Charlton & Cooper, 2003; Ekman, 2009). Omission occurs when a person purposefully leaves out important details when conveying information, and falsification occurs when details are created or changed. In the book *Telling Lies*, Paul Ekman (2009) explains that most people will use concealment as their deception tool of choice because it is cognitively less stressful. We know that

lying is cognitively taxing; therefore, when concealing, additional details do not need to be fabricated, remembered, or recalled (Gombos, 2006). Furthermore, those who conceal information do not need to have their story worked out in advance, which lessens cognitive demands. Moreover, it may be perceived as less morally reprehensive to omit details. That is, since the deceiver is telling some of the truth, omission may feel less like lying than falsification (Ekman, 2009). Concealment also comes with its own cover up if needed. That is, if the liar is confronted with the missing details, they can always feign ignorance or a poor memory.

Falsification on the other hand is more cognitively taxing and there is always the chance of a verbal slip or a wrong retelling of the story (Ekman, 2009; Vrij & Mann, 2001). Falsification almost always requires the outright fabrication of events. For example, if a person falsely claims to have been present at a specific place, when pressed for information, they must make up details about the physical location, construct events and actions, and perhaps even create people and imaginary conversations. One lie can easily become a complex and intricate fabrication of events when falsification is employed. Similarly, some deceivers will tell a story based in truth, but will falsify key events, which lessens the details that need to be remembered.

Although omission and falsification are different ways to lie, there is an abundance of literature that suggests both types will elicit verbal and non-verbal cues in the deceiver. These cues are called *deception cues* (Ekman & Friesen, 1969) and they indicate that deception is taking place without giving away the exact details of the lie.

Unfortunately, the deception cues most commonly used by law enforcement are rooted in outdated beliefs about lying behaviours.

Deception Stereotypes

A stereotype is most commonly associated with preconceptions about specific groups of people (Dovidio, Brigham, Johnson & Gaertner, 1996). When discussing stereotypes in the context of deception, the presumptions are instead made about specific behaviours, and then inferences are made about the person exhibiting those behaviours. That is, people who show specific behaviours that are associated with lying are thus deemed to be liars, and the behaviours in question are referred to as *deception stereotypes*.

Essentially, a stereotype is a cognitive categorization used by individuals to quickly process information about others and is formed through schematic processing (Hamilton & Trolier, 1986). Social cognitive theory dictates that deception stereotypes are formed in two ways. The first occurs by gathering behavioural information about people we have caught in lies. The information is either processed in “real-time” or later as a memory-based judgement. The second manner in which a stereotype is formed occurs through tacit or explicit social learning. In this case, the information about liars is passed on through the media or direct teachings. Once this behavioural information is

categorized as lying behaviour (schema creation) and generalized to all people, it becomes a stereotype (DiMaggio, 1997; Sherman, Judd & Park, 1989).

To learn more about the prevalence of deception stereotypes within the social conscious, the Global Deception Research Team³ (GDRT) conducted a worldwide study in 75 different countries and 43 languages. The study explored whether there were pan-stereotypes and widely held theories about liars across different societies and cultures (GDRT, 2006). The GDRT first asked participants how they could tell when a person is lying. A sample containing over 11,000 responses revealed that 63.66 percent of respondents claimed that liars will avert their gaze. This answer was followed by 28.15 percent of participants who indicated that liars appear nervous. In a second study, the GDRT developed a questionnaire to capture beliefs about common deception detection techniques. Again they found that across cultures over 70 percent of respondents believed liars used less eye contact; however, this time they also found that many self-regulations were also identified (e.g., demeanor, posture, self-touch). It also appeared that cross-culturally, people equated certain feelings and emotions with the act of deception. For example, participants in the study specified that they believed liars feel guilt or shame, thus their posture will reflect this (e.g., hunched shoulders, lowered head, and flushing). Respondents also indicated that liars will exhibit nervous tics that can be observed (e.g., shifting eyes, stuttering, and fidgeting).

³ The Global Deception Research Team is comprised of 91 researchers from 75 countries.

These beliefs about deception have also been tested in children as young as six years old, which speaks to how early schemas are created to form deception stereotypes. Einav and Hood (2008) found that when children were shown a video of people talking, the children were more likely to attribute lying to those speakers who consistently averted their gaze. Studies of this nature also provide evidence of the widely held beliefs about deception behaviours that focus on eye contact and body posture. The GDRT (2006) speculated that these stereotypical lying behaviours arose out of the common social expectation that people who lie should feel ashamed, and shamed people tend to avert their gaze and hold their body differently.

Complex nature of deception cues. Contrary to what people believe are deception cues, research on interpersonal relationships has shown that people deceive in their own unique ways. Buller and Burgoon (1996) suggested that there may be too many psychological variables and interpersonal communicative processes involved in deceit for constant and reliable cues to occur. To illustrate the complexity of interpersonal deception, Buller and Burgoon introduced the Interpersonal Deception Theory (IDT). According to IDT, deception is a progression of interactive communication between at least two people: the liar and the target. IDT is also based on the assumption that deceit is a cognitively taxing activity. That is, the liar is not only engaged in the lie, but must also execute many simultaneous tasks to ensure the target accepts the lie as the truth. For example, the liar will monitor the target for suspicion while delivering the primary

falsehood, as well as any subsequent lies they need to tell. The liar will then adjust their behaviour according to verbal and nonverbal messages they receive from the target.

Using the assumptions of IDT, Burgoon, Buller, White, Afifi and Buslig (1999) postulated that a deceiver's success is moderated by their social skills and ability to convey genuine interest and engagement in the interaction. Burgoon and colleagues found that deceivers were responsive to target feedback, adapted to the target's communication style, and monitored the level of target engagement. Truth-tellers also adapted to the target's communication style; however, the researchers speculated that the truth-tellers had different motives for this behaviour, such as trying to achieve comfort within the interaction.

A more apparent reason for this similar behaviour between lying and truth-telling may have been the study design. Burgoon et al. employed a within-subject design that asked participants to alternate between lies and truths. The researchers found that when asked to tell the truth, participants were motivated to appear truthful because they had just engaged in a lie. The researchers also found that social ability was positively correlated with the deceiver's ability to manage their emotions, their involvement in the conversation, and their behaviours. That is, the more socially skilled the deceiver, the more they appeared to be cognisant of their body language. Burgoon et al. concluded that sophisticated liars capitalize on behaviours believed to indicate honesty while avoiding gestures and behaviours that are stereotypically thought to indicate deception (e.g., avoiding eye contact, appearing closed or tense, unnecessary fidgeting).

When a deceiver adapts their behaviours to avoid detection it is known as a *countermeasure*. Deceivers will attempt to regulate their verbal and non-verbal behaviour to avoid revealing any deception cues. One type of behavioural countermeasure is the use of illustrators (i.e., using gestures to illustrate a verbal statement) and another type is self-manipulation (i.e., self-touch). It is a commonly held belief that deceivers will increase illustrators due to a desire to appear genuine and they will increase self-touch due to nervousness (GDRT, 2006). Although the use of excessive illustrators is often viewed as a cue to deception, deceivers do not usually attempt to decrease these movements, but instead may attempt to control these actions so they appear deliberate yet natural. Using hand gestures helps a speaker illustrate a point, or search for proper phrasing (Rauscher, Krauss & Cohen, 1996); therefore, illustrators would no doubt serve the same purpose for a speaker who is being deceitful. Furthermore, eliminating hand gestures altogether may appear unnatural or rigid, which is the opposite effect a deceiver is trying to achieve.

Sophisticated liars may, however, attempt to minimize or eliminate manipulations in an effort to appear more truthful. An example of minimizing behaviours was demonstrated in Vrij and Mann's (2001) study that explored lying behaviours and deception cues in a real-life interrogation. The researchers obtained a video recorded interrogation of a murder suspect and selected portions for analysis. The segments contained statements made by the suspect that were either truthful or deceptive (determined *post hoc* based on file evidence). Contrary to the popular belief at the time, Vrij and Mann found that the suspect actually moved less when being deceptive. The

researchers speculated that the underlying motive of this minimizing behaviour was to appear more truthful by not demonstrating stereotypical deception cues (e.g., fidgeting and self-manipulation). The researchers postulated that in this situation, the suspect had a high incentive to appear truthful; therefore, he modified his behaviour by exercising complete control over his body movements.

High-stake lies. There is a belief in the deception detection literature that a display of deceptive behaviour is related to how much the deceiver has to lose if caught in the lie. For example, if the deceiver has little to lose, they may not attempt to conceal language or physical behaviours stereotypically indicative of deceit. However, if there is a lot at stake (e.g., criminal charges or outcome of court proceedings) deception cues become more difficult to detect. During these high-stakes lies, it is thought that the deceiver will experience massive amounts of stress, and will apply large amounts of mental effort to keeping up the façade of the lie (Porter & ten Brinke, 2008). It has also been argued that because of this mental stress, any existing deception behaviours should be most noticeable.

Although high-stakes lies should be accompanied by the most salient deception cues, they are often the most successful types of lies (Vrij & Mann, 2001). This is most likely due to the lack of stereotypical deception cues exhibited by high-stakes liars. Deceivers in high-stake deception situations are most likely showing deception behaviours; however, just not the behaviour most people are trained to identify (Mann, Vrij & Bull, 2002; Vrij & Mann, 2001; Vrij & Semin, 1996). This can make it

challenging to test and identify reliable and accurate high-stakes lying behaviours and communicate them to law enforcement professionals.

High-stake deception cue identification usually involves using videotaped interviews of actual police interrogations. Using facts about the case, researchers systematically go through the video, identify when the suspect is lying, and record any deception type behaviours that are identified (Mann et al., 2002; Vrij & Mann, 2001). This technique can be problematic for a couple of reasons. First, because the researchers know that deception is occurring, they may be inclined to see cues that are not actually indicative of deception, but still categorize them as such. Second, the cues the researchers are looking for may be those identifiable as stereotypical, and thus, the actual deception cues are overlooked because they are not recognizable. One way to rectify these limitations is to identify deception cues in a controlled setting, such as a laboratory, and then test the generalizability of these cues to real-life situations.

One of the drawbacks of laboratory deception studies is the inability to create real-life high-stakes situations that are ethically sound. That is, in a laboratory study it would be difficult to make a participant believe that if caught in a lie they will face serious consequences such as incarceration, expulsion, or criminal charges without potentially causing some psychological damage. For this reason, laboratory studies are most suited for testing deception behaviours in low to moderate-stake deception situations. This type of study design may eventually lend some clues to deception in

higher-stakes situations (for a sample of such studies see DePaulo & Rosenthal, 1979; Ekman & Freisen, 1974; Frank & Ekman, 1997; Vrij, 1995 & Vrij & Holland, 1998).

Some researchers, however, have claimed that generalizing low to moderate-stakes deception behaviours to high-stakes situations is not a good research practice. For example, Mann et al., (2002) argued that in a low-stakes situation, deceivers are not likely to feel guilt or fear consequences, which may affect the saliency of the deception cues. Furthermore, the lie being told is only for the sake of the experiment and the deceiver has no real investment in the lie, and this in itself may alter the deceiver's behaviour. While Mann and colleagues have a valid point, it should be noted that the differences between high and low-stakes deception behaviours have been observed in empirical studies that have looked for deception cues based largely on stereotypical deception behaviours. Therefore, until accurate and reliable deception cues have been identified, it is difficult to say whether it was the unreliability of the cues causing the discrepancies, or if deception behaviours are truly different in depending on what is at stake to gain or lose (DePaulo et al., 2003).

Deception Cues

It is evident from the aforementioned studies that stereotypical deception cues are ingrained among people cross-culturally, among professional lie detectors, and even within empirical research. Subsequent research in this area has revealed that although people believe liars behave in a particular way, it does not necessarily make it true. A number of meta-analyses have tested the stereotypical deception cues identified by

professionals, researchers, and laypersons, and each meta-study has concluded that specific verbal and nonverbal cues, exclusively related to deceit, may not exist (Masip, Sporer, Garrido & Herrero, 2005; Vrij, 2005; Sporer & Schwandt, 2007).

Reliability of cues. In the most extensive meta-analysis to date, DePaulo et al. (2003) investigated 1338 estimates of deception (i.e., beliefs about cues associated with deception) and 158 perceived cues to deception in a review of 116 laboratory studies. DePaulo and colleagues categorized deception cues into nine types: amount of responding, detail of responding, holding back (self-control), making sense (plausibility), engaging, immediacy, uncertainty, fluency, and body activity. Contrary to the pan-cultural stereotypes of lying that were reported by the GDRT (2006), it was found that behaviours around eye contact, gaze aversion, and nervousness, were not significantly different between deceivers and truth-tellers. Furthermore, liars did not prove to be more elaborate story-tellers (amount of responding). In fact, many of the cues tested in these meta-analyses were found to be more indicative of nervousness than deception. Even the truth-tellers exhibited anxious behaviours in both interrogation and experimental situations.

Since the DePaulo et al. (2003) meta-analysis, many nonverbal deception cues have been dismissed as unreliable, when in fact; it may have been a combination of study designs and the deeply ingrained beliefs about these cues that affected the results. For example, DePaulo and colleagues noted that in all the studies that used mock crimes, only the participants who committed the “crime” were asked to lie, whereas truth-tellers

committed no transgressions. DePaulo also acknowledged that there was no standard operational definition of “lie” used amongst the studies. Also, while it is not explicitly stated, the researchers alluded to the different types of lying (falsification and omission) and how the distinction between the two should be considered in deception research; however, none of the 116 studies investigated deception cues in either of the lying types. That is, it is not currently known if the same types of deception cues present when an individual is falsifying or omitting details.

Overall, most deception cues proved to be faint and unreliable; however, the DePaulo et al. (2003) meta-analysis did reveal that the more consistent verbal deception cues included less plausibility, vocal uncertainty, word repetitions, and vocal tension. These last three deception cues are generally classified as *speech disturbances* in subsequent literature (Strömwall, Hartwig, & Granhag, 2006; Vrij, 2008), and these findings were clearly demonstrated in two of the studies included in the meta-analysis. For example, Porter and Yuille (1996) tested 18 possible verbal indicators of deceit and identified four behaviours that had statistical significance: fewer details, less coherence, more pauses, and feigning ignorance (e.g., “I don’t remember” or “I don’t know”). Additionally, Mann et al. (2002) investigated verbal deception cues using real-life interrogation footage of 16 suspects accused of felony crimes (e.g., murder, rape, arson) and found that verbal pauses increased when the suspect was lying. However, speech disturbances were later investigated by Arciuli, Mallard and Villar (2010) who found that verbal fillers such as “*um*” and “*ah*” (verbal crutches) were tactics used by both liars and

truth tellers as they recalled information, or searched for the best way to relay information. This last finding again called into question the reliability of certain speech disturbances, prompting a need for more research on verbal crutches as a reliable deception cue.

DePaulo et al. (2003) acknowledged that each study taken on its own may give the promise of identifying reliable cues to deception; however, there are a variety of reasons why the overall differences between deceitful behaviours is difficult to find. For example, the researchers established that situational stakes, individual arousal, cognitive complexities, conflicting deception theories, and diverse research designs may have contributed to the varied types of deception cues and empirical findings in the studies they analyzed. In short, there are so many variables at play in both laboratory and real-life research designs that discovering reliable and accurate deception cues may be extremely difficult, if not impossible.

Accuracy of judgements. Using deception stereotypes to determine when a person is lying has proven to be an unreliable tactic time and time again. Nearly 50 years of lie detection research has presented evidence suggesting that most people are only as good as chance (50% accurate) when it comes to correctly interpreting deception cues in either face-to-face interactions or videotaped interviews. Small gains in accuracy have been achieved through intensive training where “judges” were taught to attend to certain behavioural cues. However, the literature suggests the success rate in these situations depended largely on the type of lie, the type of training, and the type of technique or tool

used to detect deception (for a review, see Bond & DePaulo, 2008; Vrij & Granhag, 2012).

For example, Meissener and Kassin (2002) found that police investigators were no more accurate than university students when determining truth from lies (50% and 56% respectively). A sample of 44 North American police officers participated in the study, and 68 percent of them had previously taken professional training in interviewing, interrogation, and deception detection. Although the officers had chance level accuracy, they reported the highest level of confidence in their judgements. This means that even though they were incorrect half the time, they were certain they were right almost all of the time. When these findings are generalized to real life interrogation rooms, it explains how truthful and potentially innocent people can be subjected to guilt presumptive or aggressive questioning.

Vrij & Mann (2001) asked police officers to view video clips of a real-life interrogation session and indicate whether they thought the suspect was controlling his behaviour (body movements) in each segment. The officers reported significant differences between body control when the suspect was lying and when he was telling the truth; however, when asked to judge for deception, the officers only achieved a 57 percent accuracy rate. In a later study, Mann, Vrij and Bull (2004) found that officers were more likely to cite nonverbal cues (e.g., eye gaze and body movements) as indicators of deceit. The officers viewed video clips of real suspect interrogations and were asked to indicate whether they thought the suspect was lying or not. They also indicated which cues they

used to determine deception, as well as their confidence in their judgements of deception. Mann et al. found that the accuracy rate improved slightly from the findings in Vrij and Mann (2001; judgements went from 57% to 66% accuracy); however, there were differences in the two study designs. In the latter study, the officers were primed to look for deception cues and not just overall body control, which may have accounted for the slight increase in accurate judgements.

The overall conclusions in both Vrij and Mann (2001) and Mann et al. (2004) suggest that body movements such as self-manipulations and illustrators were not reliable deception cues based on the accuracy of judgements. Furthermore, the results suggested that the officers were not associating lack of movement with deception. Instead, the officers looked for increased movements and nervous behaviours, which are in line with popular police interrogation training and stereotypical beliefs.

Current State of Deception Detection

Although the scientific literature has demonstrated that stereotypical deception cues are unreliable (DePaulo et al., 2003), many tools and techniques still rely on these traditional beliefs about deceptive behaviours. Many modern deception detection techniques still point to indicators of nervousness, guilt, shame, and physiological cues (e.g., dry mouth, increased heart rate, perspiration, fidgeting, etc.) because of a perceived emotionality factor. The idea of emotionally driven deception behaviour has persisted within the criminal justice system throughout human history (Kleinmuntz & Szucko, 1984; Ekman & Friesen, 1969, 1974). There is a belief that some underlying emotion

associated with deception *leaks* out physiologically or through body movements and facial expression. This belief is still at the core of most deception detection practises. Despite the growing evidence that emotion based deception cues are extremely unreliable; the *emotional leakage* paradigm continues to be the predominant theory in current deception detection techniques.

Emotional Leakage

The idea that there are cues to deceit that “leak” into facial expressions, speech, body language, and physiological response has been the focus of a large body of research. Over the last 40 years Ekman and colleagues have been leading the research in this area by extensively studying emotion, facial expression, and deceit. From Ekman’s early research on emotion and deception, new deception detection tools and training have been developed for use in law enforcement settings (Adelson, 2004; Matsumoto, Hwang, Skinner & Frank, 2011).

Ekman’s work is grounded in emotional leakage theory, which is described as “nonverbal behaviour that escapes censorship” and reveals information associated with the message that is being concealed (Ekman & Friesen, 1969). Ekman posits that when people lie there are clues in the facial expression that can alert the target that deception is taking place. When this happens, the deceiver may attempt to mask their true feelings with an alternative expression. That is, the deceiver will use a countermeasure to try to appear truthful or sincere. For example, if a person feels contempt toward an acquaintance, they may try to cover it up with a “friendly smile”, but something in that

smile may not appear genuine to the target or others observing the smile. In this example, it is the masking of the felt emotion that provides a clue that deception is occurring (Ekman, 1985; Ekman, Friesen & O'Sullivan, 1988; Frank, Ekman & Friesen, 1993).

In early definitions, emotional leakage referred to both the body and the face; however, interest in the face alone may have gained popularity with the advent of the facial action coding system (FACS; Ekman & Friesen, 1978). FACS is a behavioural coding tool used to identify movements in the face called action units (AU). The AUs are comprised of one or more facial muscles and a sequence of these AUs create an expression. FACS is a taxonomy used to identify facial expressions and possibly even hidden expressions called *microexpressions* (i.e., brief involuntary expressions of the face; Ekman, 2002). The ability to detect and identify microexpressions has become a popular area of training for specialized law enforcement and security organizations (e.g., CIA, FBI, and Border Patrol). The theory is that these fleeting expressions are evidence of the emotion that is being masked, and are clues to potentially untoward motives. As a result, law enforcement agencies have hired trained specialists to scour video surveillance, interrogation videos, and still photographs for evidence of microexpressions or masked emotions (Matsumoto et al., 2011).

FACS can be a reliable rating tool for decoding expressions, and has the most success in clinical applications (Kaiser & Scherr, 1998; Prkachin, 2009). To date, however, there have been no published empirical studies where FACS has been tested in a forensic setting to detect deceit. Information relating to the reliability and accuracy of

FACS based techniques are entirely anecdotal (Depaulo et al., 2003; Kassin, 2012; Vrij & Granhag, 2012). This gap was somewhat addressed by Porter and ten Brinke (2008) who conducted the first comprehensive investigation of facial expressions in deceptive situations using a FACS-like technique in a laboratory setting.

Porter and ten Brinke found that when people tried to fake negative emotions (e.g., sadness, anger, fear), they were more likely to exhibit emotional leakage. This finding suggested that negative emotions and expressions were more difficult to fake; however, there was no evidence to support emotional leakage as a reliable deception cue. When investigating the occurrence of microexpressions, Porter and ten Brinke found that they were rare, infrequent, and lasted longer than traditional definitions found in literature published by Ekman and Friesen (1974, 2003). Additionally, microexpressions were also found in truth-tellers, which suggested that microexpressions were not a concrete or reliable deception detection cue. Despite the aforementioned findings, Ekman and colleagues maintained that emotional leakage could be used as a reliable deception cue. The researchers believed it would take a highly trained and disciplined individual to have complete control over their emotions and facial expressions at all times (Ekman, 2009).

Hurley and Frank (2011) tested the ability to subdue emotional leakage by using FACS to code for AU suppression in non-trained subjects (i.e., subjects that had not received specialized training in emotion suppression). They found that micro-momentary coding (FACS coding frame by frame) revealed that facial actions can be reduced, but not eliminated. Additionally, instructions to suppress one part of an expression usually

resulted in a reduction of all facial movement. Hurley and Frank did find that liars were less able to suppress brow movements when instructed to do so. The researchers speculated that this was due to cognitive demands that are present when lying. That is, the participants were too mentally focused on the lie to have complete control over their facial expressions. This finding suggests that some cognitive process, and not the leakage of emotion, produces cues to deception.

The main issue with emotional leakage as a deception detection tool is that deception does not have a specific emotion or affect attached to it. One's experience of feeling emotion, and not wanting to share that emotion, cannot be used as a reliable cue because this varies considerably across each individual and each situation (Bashore & Rapp, 1993). Reactions to specific stimuli and the subsequent emotional response are very individual phenomena, and not everyone will "leak" a specific expression or emotion when faced with questions about their involvement or knowledge of a crime. What is likely being "leaked" during questioning and interrogations are indicators of nervousness or anxiety, which may or may not be associated with acts of deception (Kassin, 2012; Vrij & Granhag, 2012). For example, an individual who has a high motive to be believed may try to appear friendly and open while masking fear. If fear is "leaked" and detected, emotional leakage theory dictates that the individual is not being genuine and should be questioned further. Depending on the type of interview technique used, even a truthful person or an innocent suspect could be branded a liar and subjected to psychologically stressful questioning.

Interview and Interrogation: Tools and Techniques

Past and contemporary deception detection techniques rely on indicators of anxiety and nervousness to ascertain deceit (e.g., stereotypical deception cues). However, in 2003, the United States National Research Council (NRC) reported that there was no theoretical explanation for fear and anxiety levels to be stronger in deceivers than in truth-tellers. This finding highlighted that anxiety-based interviewing and deception detection techniques were inadequate for differentiating between those who were lying and those who told the truth. Despite this report, emotional and anxiety based deception detection protocols continue to dominate the field of lie detection.

During a police interview or interrogation, the main objectives are to obtain a confession and gather more information about an event. The interviewers are motivated to obtain as much evidence from a suspect as possible in order to further the investigation, or to lay criminal charges and these goals often involves the use of specific tactics and techniques. Police officers have been trained to isolate the suspect and leave them alone to “sweat it out” before the questioning begins. During the interview officers the look for cues to deception and truthfulness, and these cues help direct their questions (Kassin, 1997). Unfortunately, the most popular interrogation techniques tend to create fear and nervousness in both deceitful and truthful suspects, and these behaviours are often misinterpreted as deception cues.

Behavioural Analysis Interview. One popular interrogation method used by many law enforcement agencies across North America is the Behaviour Analysis Interview

(BAI), also known as the “Reid Technique” (Inbau, Reid, Buckley, & Jayne, 2004). This method of questioning suspects was developed by J. E. Reid and Associates and involves factual analysis, interviewing, and interrogation. The interrogation portion of the process involves nine steps. Within these steps, some of the most popular tactics employ confrontation (e.g., accusations, reference to real or fictional evidence against the accused, and frequent interruptions), minimization (offering justification or explanations for the offense), and maximization strategies (insinuating that the process will be harder or conviction will be harsher) to compel the suspect to confess to the crime, or provide additional details. The initial steps of the BAI include a type of screening process. The police interviewers are trained to use various techniques to detect deceit (e.g., eye contact, body language, minor inconsistencies in events, or interviewers own ‘gut’ instincts), all of which have about chance reliability (50%) of being accurate (Meissner & Kassin, 2002; Kassin, Meissner & Norwick, 2005). Once the interviewer believes they have detected deception from the suspect, a more aggressive form of questioning begins, and an admission of guilt becomes the objective of the interview.

This type of interviewing is wrought with problems from both a psychological and legal standpoint. For example, guilt presumptive (or deception presumptive) interviews have been empirically tested and the evidence shows these interviews are more likely to elicit false confessions than any other type of behavioural or cognitive interview (Kassin, 1997, 2005; Kassin & Norwick, 2004; King and Snook, 2009; Leo, 1996). Vrij, Mann and Fisher (2006) tested Inbau et al’s (2004) expectation that liars are less helpful and more

nervous during interrogative questioning. Using the BAI, they interviewed 40 participants and found that truth-tellers were in fact less helpful and more nervous during the interview. Vrij and colleagues found that the differences between liars and truth-tellers in the BAI were the opposite of what is predicted by Inbau et al.

These findings of Vrij et al. (2006) are most likely due to the manner in which the BAI type of interview amplifies emotions. This is where emotional leakage and the BAI are at odds. Proponents of emotional leakage suggest that the effort to maintain and control emotion will cause signs of the suppressed emotion to escape through the façade and this is indicative of deceit. The BAI, however, teaches investigators to use specific techniques designed to make “guilty” suspects nervous and to use the signs of apprehension as indicators of deceit. Therefore, if emotional leakage is used, subtle clues and micro-behaviours of emotion are sought, but if the BAI is used, psychological techniques are used to elicit emotion and macro-behaviours. The inconsistency in the two techniques highlights the differences in training for various law enforcement professionals. It also speaks to how the misreading emotion as deception (using either technique) can increase the chances the interrogator will prolong the interview in an effort to obtain the “truth”.

One of the more serious concerns about the BAI is its tendency to produce false confessions. Sometimes in a BAI, the only behaviour or utterance that will not be interpreted as deception are those that fit into the interviewer’s beliefs about the events in question (Kassin, 2005; Kassin, Drizin, Grison, Gudjonsson, Leo & Redlich, 2009). Of

course, the BAI is not the sole reason for false confessions; however, the psychologically stressful and manipulative nature of this interrogation technique makes it more likely to produce false confessions than non-guilt presumptive techniques (Perillo & Kassin, 2011).

PEACE model interview and strategic questioning. The PEACE model (Planning/preparation, Engage/explain, Account, Closure, and Evaluate) is another type of questioning that uses investigative techniques to obtain information from witnesses, victims and suspects. The PEACE interview is widely used in the United Kingdom (UK) and was implemented in 1992 as an effort to reduce the number of false confessions obtained through adversarial interrogation tactics (Clark, Milne & Bull, 2011). The objective of the PEACE interview is to collect information as opposed to simply obtaining a confession. The PEACE technique permits the investigating officers to ask as many questions as necessary to piece together events or to gather leads. While the officer is not necessarily trying to actively ascertain the truthfulness of the responses to the questions, using the PEACE model allows the officer to request clarification, probe for more details, and ask further questions until he or she is satisfied with the information. It is not until the final step in the model – evaluate – that the officer will make judgements about the information, which may include opinions of veracity.

In order to ascertain whether the interviewee has provided sufficient and plausible information, the officer may suspend the interview at any time to evaluate what has been stated. The officer can then resume the interview and ask the interviewee to clarify or

elaborate on any details that seem vague or contradictory. This aspect of the PEACE model allows the officer to probe further without accusing the interviewee of lying (Clarke & Milne, 2001; Zulawski & Sturman, 2012). This technique facilitates open dialogue between the officer and interviewee, which is more likely to yield the needed information. For example, Holmberg and Christianson (2002) stated that prisoners who reported being interviewed in respectful and humane ways (e.g., PEACE model) were more likely to lie less and were also more likely to truthfully confess to a crime than those who reported being interviewed using accusatory, deceitful, or domineering tactics.

One minor drawback of this type of interview is that officers are not taught to look for cues to deception during the questioning. Although the officer is trained to use questioning techniques to obtain needed information, many officers trained in PEACE will still rely on their personal intuition to determine if an interviewee is being truthful (Soukara, Bull, Vrij, Turner & Cherryman, 2009). This could provide an opening for deception detection error and a possibility of missing the lie altogether. For example, a sincere looking, plausible, and effective liar may find it easier to lie under these conditions because the interrogative pressure is reduced. Thus, a deception detection technique that allows for respectful and non-aggressive questioning, while making it difficult to lie, may be the more ideal technique for investigative interrogation.

Polygraph techniques. Throughout history, physiological response has been the most popular deception cue used in law enforcement settings. It is thought that measuring various bodily responses (e.g., heart rate, blood pressure, respiration, and skin

conductance) to specific questions may indicate whether an interviewee was lying. The most widely used physiological lie detection tool in North America is the polygraph. Professional polygraph examiners use a variety of tests to elicit a pattern of physiological activity that can be examined for indicators of deception. The premise is that individuals who are lying will demonstrate more arousal during questioning due to a fear of being caught in the lie. Additionally, some tests rely on an assumption that the interviewee is concealing knowledge about the crucial details of a crime. A trained polygraph professional will ask specific questions based on the particular type of test they are administering. Once the questions that elicited arousal are identified, interrogators can then focus their questioning on those items (American Psychological Association, 2004; British Psychological Society Working Party, 2004).

The most popular type of questioning is the Controlled Question Test (CQT). When law professionals and researchers debate the veracity of the polygraph, it is generally this test that is at the center of debate (Fielder, Schmid & Stahl, 2002). The CQT is used most often because it has a wide variety of applications (i.e., can be adapted to suit any type of crime or questions). All questions are answered with either “yes” or “no” responses and the test is comprised of four types of questions: introductory and neutral (to habituate the interviewee), control (to serve as a baseline), and relevant (directly related to the information sought). If the physiological responses are higher in the relevant questions than the control, it is deemed that deception has taken place.

There are many problems with using a polygraph to detect deception. One challenge is heightened arousal during questioning. For example, the fear of not being believed can cause all of the same physiological responses as the fear of being caught in a lie (e.g., increased heart rate, perspiration, blood pressure, heightened startle response). The questions asked may also invoke a physiological response in the examinee if they are of a sensitive or personal nature. Furthermore, the types of control questions asked during the polygraph vary by type of crime being investigated and polygraph professional. The diversity of question type may compromise the standardization needed for a calibrated test (Bull, Baron, Gudjonsson, Hampson, Rippon & Vrij, 2004; Ben-Shakhar, 2008).

In order to get around some of the aforementioned issues, the Guilty Knowledge Test (GKT), or concealed information test (CIT), has started to gain popularity among polygraph examiners and deception researchers. The GKT is constructed to help the examiner determine whether the examinee has information about an event that they do not want to disclose. This is achieved by asking a question about the event and then offering the examinee a choice of responses, much like a multiple choice test. Within the choices is the correct answer, which only the perpetrator or someone involved in the crime would know. The examiner would then look for arousal during the correct answer. For example, the examiner may ask, “where did the police find the body?” the answers would then be “in the house, in the yard, in the pool, or in the street?” If the correct answer was “in the house”, and the examinee knew this, heightened arousal should occur when those words were heard.

Although the GKT is the most favoured among polygraph tests it still has its problems. The first issue occurs when the correct multiple choice response is more arousal eliciting than the others. That is, if one of the options was “knife” and the interviewee has an unrelated reaction to the word, it could be interpreted as arousal. The second problem occurs when innocent examinees can guess which choice is the correct answer and thus shows a stronger response to that item. Again, these issues stem from examiner training and the impossibility of question standardization due to the very nature of the test. Additionally, the fact the examiner knows the correct answer can open the process up to examiner biases (i.e., seeing a response that is not there; Ben-Shakhar, Bar-Hillel & Kremnitzer, 2002; Bull et al., 2004).

Moreover, the entire premise of the GKT relies on the assumption that the guilty party has perceived the details about the crime that are needed to respond accordingly. For example, the murderer may know they hit the victim with something hard, but may not know whether it was a bat or a lead pipe. If both these options were presented as multiple choice answers, false positives or false negatives may occur. Furthermore, the guilty party may also lack memory of the event due to trauma or the passage of time. This too will compromise the integrity of any physiological responses (Ben-Shakhar et al., 2002; Carmel, Dayan, Naveh, Raveh & Ben-Shakhar, 2003).

The polygraph has been studied extensively and the general consensus among researchers and justice officials is that it is not a reliable tool for deception detection within the legal system. It has been concluded that using physiological arousal as an

indicator of deception is not based in sound psychological theory; however, some researchers have suggested that the GKT may still be a useful tool for deception detection (Fiedler et al., 2002; National Research Council, 2003; Greely, 2004; Leach et al., 2009). Bayshore and Rapp (1993) posited that using the GKT with a psychophysiological measure may be a better way to infer deception. The idea was to measure the neurocognitive processes that occurred during deception by analyzing event-related brain potentials.

Neural correlates of deception

Over the last 20 years, deception detection research has moved from investigating purely physiological deception detection tools to exploring psychophysiological measures. Cognitive psychological studies have suggested that the act of lying largely involves many executive control functions such as working memory, inhibitory control, and the ability to task switch (for a review of the literature see Gombos, 2006). Comparatively, functional magnetic resonance imaging (fMRI) studies have shown that the regions of the brain engaged during deception are also those involved in executive function. Through research involving electroencephalograms (EEG) and fMRI, the neurological processes involved in deception have been identified. These regions include the ventro lateral and dorso lateral prefrontal cortex, the anterior insula, medial prefrontal cortex, posterior parietal cortex and bilateral inferior parietal lobule (Christ, Van Essen, Watson, Brubaker & McDermott, 2009). The number of brain regions involved in

deception demonstrates its complexity as a neurocognitive activity, and it is this complexity that makes lying difficult to measure and detect.

Electroencephalogram. The electroencephalogram (EEG) is a non-invasive way to track brain processes in a subject. When specific stimuli are detected by the subject, interruptions in time varied voltages are measured through electrodes on the scalp. These interruptions are called event-related brain potentials (ERPs) and depending on their length, it can be determined what area of the brain is experiencing neural oscillation (repetitive neural activity). An ERP is designated as either positive or negative depending on how the voltage is deflected (Bayshore & Rapp, 1993; Ganis & Rosenfeld, 2011).

One particular ERP has been identified as potentially useful in deception detection research because its occurrence is linked to the subject's response to stimuli, as opposed to the attributes of the stimulus. The P300 ERP (positive potential with 300 milliseconds latency or more) is elicited during decision-making processes and measured in the parietal lobe. Specifically, the P300 occurs when meaningful or low probability information is presented within a series of non-meaningful or high-probability information in randomly occurring trials. This attribute of the P300 allows it to map onto tests of deception such as the GKT (Bayshore & Rapp, 1993; Ganis & Keenan, 2009; Ganis & Rosenfeld, 2011). For example, a murder suspect undergoing an EEG would be expected to have a P300 response when the murder weapon is read within a long list of items not involved with the crime.

Lui and Rosenfeld (2008) introduced a new and more accurate technique for P300 analysis. Using mock-crime and GKT paradigms, the researchers examined the subsequent P300 amplitudes using spatial-temporal component analysis. This type of ERP analysis used interrelated ERP clusters and time points to capture the most relevant variance in the signal while preserving the information from the electrodes and reducing the noise among them. This means more than one electrode could be analyzed at one time and higher detection rates are possible. The researchers found they were able to identify 85 percent of liars, which was the highest accuracy rate to date. Unfortunately, this technique also yielded a 28 percent false positive hit rate in innocent participants. These findings suggest that ERP analysis for deception detection is making gains; however, more research is needed to reduce or eliminate the potential for truth tellers to be deemed deceivers.

While research into the EEG as a deception tool may be promising, researchers still do not have a full understanding of the P300 and trials have not progressed beyond the use of university students as participants. It is not currently known how accurate and reliable P300 lie detection would be in a forensic setting where the stakes are much higher and the motives for deception are more complex (Deceiving the Law, 2006).

Functional magnetic resonance imaging. The functional magnetic resonance imaging procedure (fMRI) is a neuroimaging process that measures functions of the brain by detecting the change in blood flow to those regions (i.e., hemodynamic signals). This technique is blood-oxygen level dependant (BOLD) and uses the change in magnetization

between oxygen-rich and oxygen-poor blood to create a functional map of the brain (Ogawa, Lee, Kay & Tank, 1990). The BOLD technique has excellent spatial resolution and it can localize brain processes within millimeters of the activity; however, BOLD has a slow time resolution and cannot be compared to other psychophysiological measures. That is, the time between brain activity and imaging is so delayed it cannot currently be compared to ERPs to create a complete picture of the neural processes (Ganis & Rosenfeld, 2011). When fMRI is used as a deception detection tool, laboratory studies have shown that truth and lies can be discriminated (Spence, 2004; Abe et al., 2008); however, some issues with the theoretical and practical implications still remain. For example, fMRI deception research has shown significant variations in the extent that brain regions are engaged by each individual. This means that within an area of the brain that is known to be involved in lying, each subject's neural activity is so varied it is currently impossible to pin-point an exact functional pattern of deception (Christ et al., 2009).

Davatzikos et al. (2005), hypothesized that truth and lie could be distinguished in individual subjects by classifying all functional brain activity. By examining the patterns voxel-by-voxel, Davatzikos and colleagues found that fMRI could detect subtle differences between truth and lies with 100% accuracy. The caveat was that the classification methods used were so highly honed to their specific experimental paradigm they doubted it could be generalized to other experimental models.

Monteleone et al. (2009) investigated whether group results could predict lying at the individual level and whether lies, about the self or others, could be discriminated. They found that no one area of the brain could be used to determine deception; however, the medial prefrontal cortex (mPFC) yielded the best results. Monteleone and colleagues found that 71 percent of participants were identified as being deceptive using the mPFC alone with no false positives. Despite these promising findings, the researchers concluded that brain imaging was still unable to expose the neural processes unique to deception. Their findings, however, did not indicate accurate markers of deception that could be generalized across individuals.

The regions of the brain that have been identified as functional during deception are also responsible for other cognitive and bodily functions. For this reason, hand movements have been reported to be an effective countermeasure during deception detection in an fMRI. In fact, when participants used their hands when talking, classification accuracy dropped from 100% to a mere 33% (Davatzikos et al., 2005; Langleben & Moariarty, 2013). This finding suggested that in order for fMRI to be an effective deception detection tool, the subject under interrogation would have to be completely still, which may prove unrealistic in a real life interrogation. Moreover, the effect of body movements on brain patterns may also provide explanation to the inability for fMRI studies to tease out a specific area linked to deception. That is, types of movements and the resulting brain patterns would vary from individual to individual (Happel, 2005; Ganis & Keenan, 2009).

Psychophysiological research is still fairly new within the area of deception detection. Advances in technology may eventually provide a tool to measure deception at the neurocognitive level; however, some fundamental issues must still be worked out before psychophysiological tools are used in applied settings. Apart from small sample sizes and inconsistencies in test paradigms, potential confounds in some study designs also need to be addressed. For example, EEG and fMRI studies that use the GKT are subject to the same issues as the polygraph. That is, an interviewee must have encoded the items of interest into their memory for the GKT to be effective (Ganis & Rosenfeld, 2011). Additionally, there have been no theoretical or psychological explanations offered as to why the psychophysiological processes of deception are observable. Therefore, it is unknown as to why certain areas of the brain are activated during deception and what their roles are in the process.

Using neuroimaging and ERPs to detect deception also comes with its own unique set of ethical implications. The most obvious issue is that law enforcement and society will be seduced by the neuroscience and prematurely adopt these techniques for use in legal settings. This is already the case in Pune, India, where in 2008, a neuroscience based lie detection technique was admitted into evidence. The suspect was accused of murder and subsequently sentenced to life in prison despite the outcry of disapproval from neuroscientists and legal professionals around the world. The judge in the case cited the neurocognitive evidence in his decision (Giridharadas, 2008). Another ethical issue arises with suspect privacy. EEG and specifically fMRI could lead to information being

discovered about a suspect that they did not know, did not care to know, or may not have chosen to divulge. For example, brain anomalies or medical disorders such as brain tumors may be discovered during the process of deception detection. Of course such irregularities could be used by defense attorneys to argue criminal responsibility; however, the suspect's right to medical privacy, and any legal implications, must be considered before psychophysiological tools are widely used for deception detection (Happel, 2005).

EEG and fMRI still have a long way to go before they can be used in a legal setting; however, neuroscience has started to demonstrate that the cognitive processes may be the future of deception detection. Understanding the cognitive mechanisms of deception may also allow for the development of tools and techniques that can be applied directly to forensic psychology without the need for advanced neuroimaging tools, or an advanced degree in neuroscience. Perhaps understanding the cognitive underpinnings of deception is what is needed to finally identify deceptive behaviours and cues.

Cognitive Theory

Cognitive theory (CT) originated in the 1980s with the advent of *cognitive science* and was fully developed by the 1990s in an attempt to explain behaviour through understanding thought processes, memory, and attention. CT can be divided into two sub-theories: Cognitive Social Theory (CST; learning to model the behaviour of others) and Cognitive-Behavioural Theory (CBT; how cognition influences emotional behavioural responses). When examined in the context of deception, CST explains deception as a

social process whereas CBT provides insight as to why the act of being deceptive may have an emotional impact on some people and not others. For example, with CST, successful liars learn through observation and social contact what types of lies and what lying strategies are plausible and socially acceptable. Through CBT, the deceiver learns how to behave in a believable manner and how to control their own stereotypical deception behaviours. Deceivers also learn how to moderate their behaviour to increase their chances of the lie being accepted. CT also helps to explain the variability in deception behaviours. That is, a person's experiences, worldview, and beliefs are filters that information must pass through before a behavioural response is given (Gombos, 2006). In short, all aspects of CT provide the framework needed to further understand the cognitive processes of deception. To further understand how CT may be the key to unlocking many of the mysteries of deception and deception detection, working memory and cognitive load will be the primary focus.

Working Memory

Working memory (WM) is the system that temporarily stores information as well as retrieves information from the short-term (STM) and long-term memory (LTM). WM is responsible for rehearsing stored information and any new information placed in the WM is lost within 20 seconds if it is not learned (i.e., encoded into the short-term memory). WM also operates as a mechanism for executive attention (Baddeley & Hitch, 1974). In learning and attention research, WM capacity is measured by the ability for one to use attention in order to maintain or suppress information. WM capacity has been found

to be positively correlated with higher-order cognitive function and people with high WM capacity tend to perform better on tasks such as reading comprehension, complex learning, and reasoning skills (Engle, 2002). High performance in complex cognitive function is directly related to the individual's capability to focus on the task at hand and minimize outside distractions.

Cognitive inhibition (CI) is the ability to ignore irrelevant stimuli in the environment and focus on a specific task, or the current state of mind (e.g., emotions, feelings). CI is also responsible for stopping trains of thought or suppressing information from the STM and LTM.⁴ When thoughts are suppressed it can be deliberate, or an automatic process triggered by some other cognitive function (MacLeod, 2007). Whether CI is initiated by an act of will or involuntary reaction, inhibition is the part of the WM system that regulates attention.

Cognitive Load

Inhibition, recall, encoding and attention all load on the same factor of WM. This means that engaging the WM is a cognitively taxing process under normal conditions (e.g., social and behavioural learning, lying, remembering). Miller's (1956) Information Processing Theory demonstrated that STM is limited in the number of simultaneous elements it can contain. When additional data/ information is added to STM items already

⁴ There is some discussion in the literature about the differences between cognitive and neural inhibition. CI is about thought suppression, repression, and restraint, whereas neural inhibition deals with the biophysiological process of individual neurons stopping elements of thought. It is essentially the differences between the theories of neuroscience, and the theories of cognition and the mind (for a full review see Gorfein & MacLeod, 2007).

stored there become lost. The constant retrieval and encoding of information from STM requires the use of attentional resources. While this is happening, the LTM is also engaged to extract *schemata* as needed (i.e., complex organized patterns of thought or behaviour that categorizes information and relationships between the information). These schemata make up our knowledge base and help facilitate learning (Sweller, 1988). This process also requires attention, which engages the WM.

Normal attentional demands on WM capacity are called *intrinsic load* as they are intrinsic to the demands of cognition (e.g., memory, thought, communication). Intrinsic load cannot be reduced by instructional manipulations or altered by communication as it is a base load that is always present. This type of load does increase with the demands of a task or process, and if the task is simplified or removed, it will decrease back to baseline load. Conversely, when an external demand in the environment is increased, or a task is made more challenging (e.g., difficult questioning, increased distraction, or tasks beyond expertise), attentional loads increase exponentially. As more attention is required, the demand on WM goes up. This is referred to as *extraneous load* (Paas, Renkl, & Sweller, 2003). The combination of the different types of load on working memory is referred to as *cognitive load (CL)*⁵.

⁵ A third type of load is *germane*. Germane load is central to theories on learning as it can be manipulated by teaching style and content of the material. This type of load enhances learning through schemata acquisition.

Cognitive Theory and Deception

Over the last decade, cognitive load theory has emerged as a new area of study in deception research. Over 60 years of behavioural and cognitive research on memory, attention, inhibition and learning has produced a theory that may explain the cognitive process of deception. Moreover, cognitive theory may also provide a rationale for a deception detection technique that is not confined by the unpredictability of emotions, but is grounded in cognitive science. Even in the height of emotion-based deception detection research, there have been numerous models and theories proposed that touched on the cognitive process of deception. Each of these theories and models hinted to the importance of understanding how cognition and deception were linked; however, none of the theories provided a thorough explanation of how mental processes worked together during the act of deception. What they did offer, however, was the ground work to point deception research towards solid theoretical ground.

Four-Factor Model. Zuckerman et al. (1981) were the first to suggest that the key to understanding deception may be to understand the mentally taxing nature of the cognitive processes involved in its execution. Zuckerman and colleagues proposed a four-factor model based on arousal, emotions, body control, and cognitive components. Zuckerman et al. proposed that a deceiver must be engaged in all four factors at once while engaging in deception. They argued that while being deceptive, generalized arousal increased (cognitive load), emotions associated with guilt needed to be hidden (inhibition), while verbal and non-verbal behaviours needed to be controlled. Although

the researchers alluded to the underlying cognitive process in their model (i.e., that deception is a cognitively taxing endeavor), Zuckerman et al. did not describe *how* deception took place from a cognitive perspective. Regardless, of this oversight, the researchers had started a process for other researchers to build upon.

Preoccupation Model of Secrecy. Lane and Wegner (1995) presented the Preoccupation Model of Secrecy, as their contribution to the cognitive correlates of deception. The secrecy model worked on the assumption that a deceiver will use *thought suppression* to successfully deliver a lie. This model defined deception as an act of omission (i.e., the suppression of information one knows to be true) and did not account for acts of *commission* or falsification. Lane and Wegner posited that when one does not want to reveal truthful information, they suppress their thoughts. When this happens, the suppression will then trigger intrusive thoughts, which in turn cause renewed efforts of suppression, and the process starts all over again in a circular fashion. What Lane and Wegner were actually presenting was a model of inhibition for one type of deception (i.e., omission). That is, the truth was being suppressed through executive functions and schemata were retrieved appropriate to the situation (e.g., plausibility, how to appear truthful, and deception stereotypes). Unfortunately, Lane and Wegner's model was incomplete because it did not include the executive processes needed to falsify, which is a type of deception that requires substantial cognitive resources.

Interpersonal deception theory & Self-preservation theory. The interpersonal deception theory (IDT) postulated by Buller and Burgoon (1996) focused on the

complexities of deception in communication. Based on these intricacies, Buller and Burgoon argued that deception was a cognitively taxing task. Additionally, IDT worked on the assumption that deception involved behavioural and cognitive inhibition. This means a deceiver has to suppress verbal and non-verbal cues to successfully execute the lie. While the researchers did not draw the comparisons forthright, they were describing the mediation of internal and external information through executive cognition. In this aspect, IDT mirrored many of the ideas presented in Self-Presentation Theory (DePaulo, 1992).

Self-presentation Theory suggested that body and speech regulation along with behaviour modification were involved in the underlying workings of deception. DePaulo argued that deceivers used their social skills and control over nonverbal behaviours to feign internal states (inhibition) and deliver a convincing performance to their target. These ideas map on to Cognitive Social Theory (CST) perfectly. That is, CST states that one's personal experience (skills) will interact with behavioural determinants (nonverbal behaviours) and environmental factors (target) and will ultimately affect the outcome of the cognitive process.

Activation-Decision-Construction Model. Although each of the aforementioned researchers offered theories and models that touched on the cognitive processes of deception, none provided an actual model of the cognitive foundations until Walczyk, Roper, Seemann and Humphrey (2003) presented their Activation-Decision-Construction Model (ADCM). The ADCM explained the cognitive underpinnings of deception using

short answers measured by reaction times. The model relies on three well accepted assumptions of cognitive theory and working memory: 1) Semantic LTM stores quick access information (schema), while the episodic LTM stores chronologically ordered biographical information, 2) when LTM is activated, nodes are primed through an activation that spreads and quickly decays, and 3) it takes ≤ 400 ms (milliseconds) when truthful information is retrieved from LTM to WM.

The ADCM states that once a question is posed, it enters an articulatory loop (activation) and then a decision to tell the truth or to tell a lie is made. Walczyk and colleagues theorized that when the truth was told, a response would be produced in less than 400ms; however, if a lie was being fabricated, it would take longer for a response. The delay in response was presented as four additional steps that needed to be taken before a response was produced. Once the decision to lie had been made, attention was required to construct a lie (construction). Here, the LTM and WM was engaged as social cognitive knowledge and context work to inhibit potential lies as needed (i.e., plausibility is assessed based on previous experience, environmental factors, and behavioural cues of the target). After this process was complete, a deceptive response was given. Walczyk et al. found that lies took approximately 200ms longer to produce (600ms in total). These results were supported by Farrow et al. (2003), who also used reaction times in their research to differentiate truth from lies. Farrow et al. found that regardless of sex and how the questions were presented (verbally vs. visually), participants took approximately 230ms longer to respond when they were being deceitful.

Time-Based Resource Sharing Model. Barrouillet, Vergauwe, Bernardin, Portrat and Camos (2007) suggested a model that demonstrated how CL is a function of time during which attention is captured. Their Time-Based Resource Sharing Model (TBRS) operates under four assumptions of cognitive load: a) within WM, processing and maintenance of information rely on the same limited resources, b) many of the basic steps for maintaining and processing information can only occur one at a time, c) items in the WM which are attention focused will be lost in a short period of time once attention is switched away, and d) attention is shared between maintenance and processing by rapid switching.

Although TBRS was not created with deception research in mind, the model produced two findings that could be directly applied deception detection techniques. By using reaction time tasks that involved numbers, words, letters, or spatial reasoning, Barrouillet et al. (2007) found that tasks that added demands to attention impeded the switching of attention between processing and maintenance of information regardless of information modality. That is, if CL exceeds the individual capacity of WM, automated cognitive processes begin to break down and schema acquisition is delayed. Additionally, the method of inducing cognitive load did not matter (i.e., numbers, words, special processing, etc.), all that was important was the attentional effects of the added load. Barrouillet et al. explained the delay in reaction times as a “trade-off” phenomenon. As the demands on WM increase, performance decreases, which is evidenced by specific verbal and non-verbal behaviour.

Cognitive load interview

Research on deception has found that when liars are anticipating an interview, they will attempt to prepare their stories and plan their deception (Hartwig, Granhag & Strömwall, 2007). Typically, planned deception tends to produce fewer and less noticeable deception cues. One way to combat this countermeasure is to exploit the cognitively taxing nature of deception. There are currently two types of experimental paradigms that use the cognitive approach for deception detection. One kind measures response times and body movements (i.e., self-manipulations and illustrators; Walczyk et al., 2003; Sporer & Schwandt, 2007) and the other type increases the cognitive demand on interviewees to create observational differences between liars and truth-tellers (Vrij, Fisher, Mann & Leal, 2008a; Vrij, Granhag, Mann & Leal, 2011; Vrij, Leal, Mann, & Fisher, 2012). The underlying theory in either approach relies on the assumption that as cognitive load increases, attentional resources will be used up and subtle behaviours that exist during deception will become more salient. As previously mentioned, stereotypical deception cues are faint and unreliable (DePaulo et al., 2003); however, inducing cognitive load seems to amplify these cues.

Vrij, Mann, Fisher, Leal, Milne and Bull (2008b) have suggested an alternative type of interview approach that further increases cognitive load through strategic interviewing. Vrij et al. hypothesized that an effective way to increase cognitive load was to have deceivers tell their story in reverse chronological order. In two experiments, the effects of cognitive load (e.g., retelling events in reverse order) were tested on the

interviewees in both truthful and deceitful conditions. The researchers tested 14 stereotypical cues to deception and found that five cues emerged as reliable differentiators of liars and truth-tellers. The first three were fewer auditory details, fewer contextual details, and more speech disturbances (e.g., speech hesitations, spoke slower, more speech errors). The fourth and fifth were frequency of speech errors (stuttering, word repetition, starting over) and eye blinks.

Vrij and colleagues also found that observers could better discriminate deceit and truth when interviewers imposed mentally taxing interventions on the interviewee. Fifty-five police officers were asked to view video tapes of interviewees recounting their stories. Of the 24 videos shown, 12 were in chronological order and 12 were in reverse order. Additionally, 12 of the videos were truthful recounts of events and 12 were lies. The police officers were able to detect 42 percent of the lies in the chronological condition; however, they were able to detect 60 percent of the lies in the reverse order condition.

In a separate study, Vrij, Mann, Leal and Fisher (2010) replicated the methodology of the reverse order study; however, they induced CL differently. Instead the researchers used eye contact to increase the attentional demands in the interviewees. Vrij et al. (2010) found that the results were comparable to their previous findings. While none of the interviewees were able to maintain eye contact for the duration of their answer, deceivers in the eye contact condition exhibited more deception cues than truth-tellers in the same condition. Eye contact is thought to increase cognitive load because it

requires a lot of attention and cognitive resources to maintain (Doherty-Sneddon, Bonner & Bruce, 2001; Doherty-Sneddon & Phelps, 2005). While people tend to make eye contact when they communicate, the natural tendency is to look away periodically. Although previous research has suggested that the sophisticated liar may be more inclined to maintain eye contact with his target, this is achieved in a careful and natural manner. This means the deceiver who willingly maintains eye contact is doing so on their own terms in an effort to gather behavioural information from their target to retrieve schemata and formulate the appropriate responses. When an interviewee is told to maintain eye contact, it becomes a task that draws attention away from schemata retrieval because eye contact has become the new focus instead of the lie.

Another way to increase cognitive load is through the unanticipated question and strategic use of evidence technique (Hartwig, Granhag, Strömwall, & Kronkvist, 2006; Tekin, Granhag, Strömwall, Giolla, Vrij & Hartwig, 2015). This technique is especially effective for thwarting the plans of the prepared liar (Vrij et al., 2011). When this tactic is used, the interviewer asks the interviewee to provide as much detail as possible. Throughout the interview the interviewer will prompt for even more information, thus increasing the cognitive load. Finally at a strategic point in the interview, the interviewer will ask about a known detail, piece of evidence, or a question that is relevant to the case, but unexpected given the previous line of questioning. The latter is the unanticipated question, and it has been found to be effective in amplifying deception cues, especially

when comparing the answers of multiple suspects about the same crime (Vrij et al., 2009).

Eye Blinks: Possible Cue to Cognitive Load and Deception

One of the most promising cues to both deception and cognitive load is blink rate. Blinking is a semi-automatic function of the eye that can be affected by the internal and external environment. A blink typically lasts 100 – 400ms in humans (Schiffman, 2001) and is characteristically defined as a rapid closing and opening of the eyelid. Blinking occurs in two ways: reflex and spontaneous. Reflexive blinking occurs in response to external stimulus such as an irritant or object close to the eye. Spontaneous blinking occurs without any conscious effort and is controlled in the pre-motor brain stem in a manner similar to many other automatic processes (e.g., breathing and digestion). It is the latter type of blinking that may also be linked to cognitive processes and mental load.

Holland and Tarlow (1972) hypothesized that the rate of blinking was associated with specific types of cognitive activity and that blinking should decrease as mental load increased. In their first study, the researchers used a sequence of numbers to induce various states of mental load (4, 6, or 8 digits long). It was expected that memorizing eight digits would produce the most mental load based on previous memory research (Miller, 1956). Holland and Tarlow found that blink rate was a function of digit span and that less blinks were observed with longer digits. The researchers speculated that blinking disrupted or inhibited specific cognitive processes that may interfere with retaining the digits; therefore, blinking was reduced when the mental load was increased.

Bagley and Manelis (1979) set out to replicate the work of Holland and Tarlow (1972) while adding the condition of an informed participant. Bagley and Manelis informed one group of subjects that their blinking would be monitored to see if it had an effect on the outcome. The researchers found that the rate of blinking was slightly reduced in the informed group; however, the overall result was the same – blink rate was still inversely related to task difficulty. This finding was important because it provided evidence that suggested that it did not matter whether the subject was aware that their blinks were being monitored.

Although the empirical evidence has provided support for blink rate as an indicator of mental load, there was still a question as to what other cognitive processes blinking could point toward. In a subsequent study, Holland and Tarlow (1975) found evidence to support the relationship between blinking and thinking. They found that when the participant was asked to perform a silent mental activity (e.g., internal counting), blinking was significantly reduced. The researchers inferred that blink rate was low when information in the memory was engaged. They summarized that blinking was suspended during certain cognitive activities because it may disrupt them. That is, when the working memory encodes or retrieves information, blink rate is reduced because blinking interrupts this cognitive process. The interruption occurs because operational memory and visual imagination (i.e., visualization within the “mind’s eye”) share parts of the visual perception system. Since blinking disrupts the visual field, it is thought that closing the

eye, even momentarily, may disrupt the other internal processes as well (Vredeveldt, Hitch & Baddeley, 2011).

Fukuda (2001) investigated blinking as a possible indicator of deceit by administering the GKT and a dual modality task. Using eye tracking technology, Fukuda found that blink rate differentiated between relevant and irrelevant stimuli in the GKT, and that blinking peaked after stimulus disappeared during the dual modality task. These findings suggested blinking as an automatic cue that could be used during the GKT. It also provided additional evidence for blinking as an automatic response to the alleviation of mental load. That is, blinking increased (peaked) in the five seconds after the mental load inducing stimuli was removed. This finding was further supported by Siegle, Ichikawa and Steinhauer (2008), who found that most blinks tend to occur during early sensory processing and following continuous information processing.

Leal and Vrij (2008) also investigated eye blinks as a possible deception cue. They hypothesized that the cognitive demands of lying would decrease eye blinks and that blinking would increase after the lie was told. The researchers used eye tracking technology to get an accurate blink count. They found that blink rate differentiated between liars and truth-tellers. In fact, when telling the truth, participants had an increased blink rate, which then dropped to baseline once they stopped responding. Liars, on the other hand, had reduced blinks that peaked after the lie and then returned to baseline. Leal and Vrij speculated that this peak was a type of compensatory effect needed to relieve the mental load.

In a later study, Leal and Vrij (2010) tested their previous results in the context of the GKT. To differentiate their study from previous and similar studies (e.g., Fukuda, 2001), the researchers used a mock crime experimental paradigm in a moderate-stakes condition where they induced cognitive load. Half the participants were innocent truth-tellers and the other half participated in the mock crime and were asked to lie about their activities. Leal and Vrij found that blink rate could be used to distinguish liars from truth-tellers during this more real-life scenario and also while using the GKT.

Although blink rate has been established as an indicator of cognitive load and a discriminant of truth and lies, there are still questions that need to be answered before it can be declared a reliable and accurate deception cue. First, it must be determined whether human observation can pick up the differences between blink rate during deception and truth-telling or if specialized equipment is required (e.g., eye tracking equipment). Second, the only deception detection tool used during the previous studies was the GKT. Thus, it has not been established whether alternative (or other) deception detection techniques will produce reliable outcomes. That is, it is unknown whether blink rate will still differentiate deception and truth during a cognitive interview, during a traditional interrogation, or an interview where cognitive load is induced. Furthermore, no research exists to date regarding the type of lie and the rate of blinking.

The aforementioned studies have tested deception as a whole; however, it is well established that individuals lie in various ways (i.e., omission and falsification, or some combination of the two). Since omission involves telling some of the truth, it is unknown

how this variable may affect blink rate. Finally, it is also unknown how anticipating the interview and preparing the lie will affect blink rate as a deception cue.

Present Study

In order for deception detection to work, it must be based on a well-founded theory that can differentiate how people respond when they deceive and when they tell the truth (Kassin, 2012; NRC, 2003; Vrij & Granhag, 2012; Walczyk, Igou, Dixon & Tcholakian, 2013). Deception detection techniques must accurately predict the behaviour that will occur when someone is being intentionally deceptive. As outlined in the preceding review of the literature, there is an abundance of studies that have identified somewhat reliable deception cues that can be used in forensic settings (e.g., speech disturbances and blink rate). It has also been established through empirical study that deception detection using “emotional leakage” and many physiological markers used in polygraph are not based on sound psychological principles (for a review of selected literature see Bayshore & Rapp, 1993; NRC, 2003; Bull et al., 2004; Ben-Shakhar, 2008; Gombos, 2006; Vrij & Granhag, 2012). There is no current psychological evidence that exists to suggest that liars alone exhibit physiological responses, masked facial cues, or nervous behaviours when lying. In fact, it has been repeatedly shown that truth-tellers will exhibit the same behaviours as liars when nervous or experiencing stress (DePaulo et al., 2003). It is for these reasons a new approach to deception detection is needed.

One such approach is cognitive load theory, which is based in established empirical research on cognition, cognitive processing, and memory. Cognitive load

theory in relation to deception detection is a fairly new concept and has been studied by only a handful of researchers over the last fifteen years. There are many more questions that need to be answered before cognitive load can be deemed an accurate and reliable deception detection tool. To my knowledge, the previous literature has not examined any relationship between inducing cognitive load and different deception types (falsification and omission). Additionally, it is not known how deception type may influence the presentation of deception cues such as speech disturbances and blink rate. Finally, little is known about cognitive load and how deception type may influence the use of detection countermeasures, or how they affect the presentation of nervous or anxious behaviours. The proposed study aims to address two fundamental gaps in the current literature:

1. Does deception type influence the presentation of deception cues?
2. Does cognitive load produce more salient deception cues when a deceiver falsifies or omits?

Understanding the relationships among lying type and cognitive load will add to the current literature on deception and deception detection. Although this study explored deception and cognitive load in a controlled environment, the findings may have applied implications in law enforcement settings. Inducing cognitive load to detect salient deception cues may work well with more investigative type questioning such as the PEACE model and witness interviews. Moreover, the present study speaks to some of the recommendations suggested by Walczyk et al. (2013) for advancing the field of cognitive

lie detection: deception detection based in sound psychological theory, resistant to countermeasures, and useable by human observers.

Study Design

Design and variables. A 2 (deception type) x 2 (cognitive load) mixed experimental design was used to answer these questions. The between-subjects independent variable was deception type. The participants were randomly assigned to either the falsification or omission condition. A between subject approach was chosen for this variable so the lying styles could be observed in a controlled fashion to determine if group differences existed.

The within-subject independent variable was the induction of cognitive load. The present study used the memorization of a seven digit number to induce cognitive load. Observation of the interviewee's deceptive behaviour without manipulation occurred during the three questions where cognitive load was not applied. Within the interview each participant was asked seven questions, three with cognitive load induced and four without experiencing additional cognitive load. The first six questions focused on the details of a video the participants were asked to watch and lie about. The order of the questions remained the same for each interviewee; however, the application of cognitive load for each question was counterbalanced across all interviews. That is, the questions where cognitive load was induced varied from participant to participant. Counterbalancing the cognitive load across the questions controlled for the possibility that question type and wording may have had an effect on the saliency of deception cues.

The outcome variables in the present study were specific deception cues. Previous studies suggested that blinking and speech disturbances have been linked to both cognitive processing and deception (Leal & Vrij, 2008). DePaulo et al. (2003) also suggested that the lack of illustrators could be used as a reliable cue. These non-stereotypical deception cues were of primary interest in the present study; however, stereotypical deception cues have not been previously investigated in the context of lying type and cognitive load, therefore, they were also included for observation (i.e., eye contact, manipulations, and response length). Each interview was recorded, and the outcome variables were scored by frequency after the interview. This allowed for coder verification, and accuracy analysis. See Appendix A for all cues that were coded, and their operational definitions.

Hypotheses. Based on the aforementioned research, I expected that deception type would influence the saliency of deception cues. Specifically, falsification would elicit the most noticeable deception cues because creating a story should increase the cognitive demands on working memory more than the omission of details. Additionally, by increasing cognitive load during an interrogative interview, deception cues should have been further amplified. That is, a deceiver who falsified while experiencing additional extraneous load should have produced the most salient deception cues. To test this theory, three hypotheses were proposed:

H1: There would be a main effect of cognitive load on deception cues. Cognitive load will amplify deception cues regardless of deception type.

H2: There would be a main effect of lying type on deception cues. There would be less blinking and more of the other deception cues in the falsification condition than the omission condition overall.

H3: There would be an interaction of deception type and cognitive load such that in the falsification condition there would be the most salient deception cues relative to all other conditions. Specifically, response length, verbal crutches, pauses, eye closures and manipulations will increase and eye blinks, eye contact and illustrators will decrease.

The present study also aimed to investigate some exploratory questions regarding deception type. Since falsifying feels more like lying and deceiving, I expect that the falsification condition would contain more reports of interrogative countermeasures, as well as more reports of nervous and anxious symptoms.

Method

The present study recruited various members of the population. All participants completed the tasks individually. The participants viewed a video of an event and were then asked to either falsify or omit details of the event when interviewed. Demographic questionnaires and personality surveys were administered to determine whether personality traits and demographic characteristics had an influence on deception behaviour. All interviews were videotaped and outcome variables were identified and then scored at a later date.

Participants

A total of 101 participants were recruited from a local university ($n = 78$) and the general populace ($n = 23$). Undergraduate university students ($n = 63$) received two credit points towards a psychology course of their choosing. All participants were entered into two draws for one of two \$50 gift cards from a vendor of their choosing. The participant sample was comprised of 65 females ($M_{age} = 26.1, SD = 9.86$) and 36 males ($M_{age} = 27.1, SD = 12.03$). One participant's data were excluded from the analysis because her responses were not video recorded ($N = 100$).

Measures & Materials

Study environment and apparatus. The study took place in a psychology laboratory equipped with a computer for recording questionnaire responses and viewing the video. The laboratory also had an "interview area". A high definition video camera was positioned on a tripod and aimed at the chair of the interviewee. The interviewee was recorded from the lap area up so their entire torso, head and hands were visible. The interviewer was positioned across from the interviewee near the camera, but out of the recording view.

Video Stimulus. A short video (1:43) that captured a real life hit and run between at least two vehicles (non-fatal and no injuries) was used as the stimulus event in this study. The video depicted what appeared to be a minor crash between two SUV type vehicles. It begins with a woman standing outside her damaged vehicle while on her cell phone. Suddenly, the second vehicle attempts to leave the scene; however, onlookers

eventually force the vehicle to stop a short distance down the street. After a minor altercation with the one of the victims and onlookers, the driver eventually speeds away dragging a piece of the other vehicle under it. The video then appears to be edited by the owner of the footage and shows two police cars speeding down the road in the direction of the fleeing vehicle. The video is publically available on You Tube (https://www.youtube.com/watch?v=gg_tjCgCnLQ) and permission was not needed for its use.

The video stimulus served many purposes in the study. First, it provided a consistent event for all participants to observe and build their lies upon. Second, it provided documentation of the truthful events; therefore, it can be determined whether the participant actually lied about what they viewed. Finally, it provided the temporal and descriptive elements needed to for the interview questions. The video contained audio; however, participants viewed the video without sound. This step was taken to minimize distractions and also ensured the participant paid close attention to the action in the video as opposed to the dialogue. Sound was also removed to eliminate the potentially offensive and foul language throughout.

Video equipment and editing. Digital video of the participants' interview was captured using a Canon Vixia HF R500 full HD camcorder. The camcorder was compact and mounted in plain view on a tripod directly across from the participant in the interview area. Video was saved on a 16MB data card and transferred daily onto a laptop for storage and editing. The videos were edited using Windows Movie Maker version 2012.

Manipulation, confidence, and experience checks. A short questionnaire was completed after the participants watched the video. This was to ensure that the participant watched attentively and picked up on certain details (see Appendix B).

A self-report questionnaire was also administered to capture how motivated the participants were to succeed in the lies. Additionally, the questionnaire captured participants' rating of confidence in their lying abilities and their ratings of nervousness (common symptoms of anxiety retrieved from www.helpguide.org). Participants were also asked to identify any behavioural countermeasures that they may have used to appear more truthful and to check of any symptoms of nervousness or anxiety they may have felt. The questionnaire also served as a manipulation check to make sure the participant understood the different types of deception they were asked to use, and to determine whether they followed directions. Furthermore, participants were asked to explain how they know when someone they are familiar with is lying to them and how they know when a stranger is lying (see Appendix C).

Interview questions and interviewers. The participants were asked the exact same seven questions in the exact same order. Order effects of the questions were not anticipated as each question was independent of the others. The interview was constructed to flow in a logical and conversational order as would be seen in an investigative type interview. The first six questions followed the logical flow and were focused on the details of the video (e.g., "Describe the vehicle that left the scene"); however, the last question was designed to be an unanticipated question ("Where were you last night

between 6 and 7pm? Describe your activities in detail”). For a list of interview questions, see Appendix D.

Two individuals conducted the interviews for this study. One interviewer was blind to the study design and hypotheses; however, the other interviewer had full knowledge of the study. Each interviewer was assigned a code that was used to analyze the data based on who conducted the interview. This analysis was used to ensure there were no interviewer effects on the outcomes of the study (see Results: Effects of Interviewers). Interviewers were trained using the script in Appendix D.

Video coding and coders. Each participant’s video was cut into seven clips that only included the participant’s response to each question (100 usable videos x 7 clips for each video = a total of 700 coded video clips). Each clip was edited to start exactly when the interviewer finished talking and to end just before the interviewer asked the next question. The interviewer was instructed to leave at least a five second pause between the end of the participant’s response and when they asked the next question.

Three individuals were trained exclusively as coders for the present study. Each coder received two hours of training to identify the behavioural cues of interest, and instructed on how to fill out the coding guide (Appendix A). Each coder also received a further 20 hours of practice and feedback. Coders met weekly for three weeks to score test videos and establish a preliminary interrater agreement (80%) before scoring the study materials. While coding the study materials, the coders were blind to the deception

condition, the questions asked, and whether cognitive load was applied. Coding required counting the frequency in which specific behaviours occurred within the clip.

Procedure

The instructions to the participant involved deception by the researcher in order to mitigate demand characteristics in the participants. That is, if the participant knew the study was investigating deception or lying behaviours, they may act in stereotypically deceptive ways. The purpose of this study was for the participant to behave deceptively, but in a natural way. To achieve this, the participant was told that the goal of the study was to examine how people describe events they have seen and how the target (i.e., the interviewer) puts the story together (see Appendix E for complete script). Thus, participants were told that the researcher was investigating communication and story-telling styles. Participants were asked to review the informed consent form (Appendix F). The Participant was directed to a computer where they completed a short demographic questionnaire (Appendix G) using Medialab software.

Once the questionnaire was completed, the participant was instructed to watch a video and to pay very close attention because they would be asked to answer questions about the details with a separate interviewer. Participants watched the video once without audio. They were then asked to answer five short questions in MediaLab to make sure they understood what was happening in the video. Next, the investigator gave the participant instructions on their specific deception type, which was randomly assigned by the software. The participant was told that some people were asked to tell the story of the

accident in the video in as much truthful detail as possible, while others were asked to lie about what they saw. In reality, there was no truthful condition for this study. The participant was then instructed that they were in the lying condition and would be lying in a very specific way (either falsification or omission).

The participant was then informed that the interviewer would ask specific questions and that they must answer the question, but they must always lie about the details by using the deception type that was assigned to them. The participant was also told that the interviewer knew that the video involved a hit and run motor vehicle accident, and that the interviewer knew some of the participants may be lying about the details; therefore, they needed to appear as truthful as possible.

The participants were also told that the interviewer had some tasks that needed to be completed during the interview, and if they were successful, they would receive additional ballots for the gift card (all participants received one ballot for each draw regardless of their success with the memorization tasks). Although at this point the participant was not informed as to what the task would be. The task was mentioned to add motivation, bit of stress and some challenge to the situation. The investigator then asked the participant to paraphrase the instructions back to them, and to provide an example of their deception type, to ensure understanding. The participant was then seated in the interview area and given instructions regarding the videotaped interview (see Appendix D). Once the participant indicated understanding, the investigator left the room and the interviewer entered.

When the interviewer entered the room she did not engage or acknowledge the interviewee, but simply turned on the camera, took the seat directly across from the participant, and started the interview. At the end of the session, the interviewer turned off the camera and left the room, at which point the investigator returned to complete the study. The participant was directed back to the computer and asked to complete the self-report questionnaire. At the end of this questionnaire, participants had the option of providing their email address if they wished to be entered into the draws for the gift cards. Once the questionnaire was completed, the participant was fully debriefed and the true purpose of the study was fully disclosed (Appendix H). The participant was then given an opportunity to ask questions.

Results

The analysis was divided into sections. The first section includes some preliminary analyses and assumption checks to ensure suitability of the data analyses. In the next section variables that may have influenced outcomes (e.g., confidence, countermeasure tactics, and anxiety symptoms) are discussed. These steps were taken to identify any potential outliers or anomalous findings, and to determine the eligibility of the participants' data in the study. In the final section contains the findings regarding the main hypotheses, which tested a) the main effect of CL on deception cues, b) the main effect of falsification on deception cues, and c) any interaction of falsification and CL on the various deception cues. Any within-subject effects of cognitive load will also be discussed. For all hypotheses testing, Cohen's d was used as a measure of effect size.

Guidelines for small (.20), medium (.50), and large (.80) effect sizes were based on Cohen (1992).

Coding Reliability

To assess interrater reliability, 20 videos (140 clips, or 20% of total clips) were randomly selected and scored by two raters. Coder reliability met the criteria for *substantial agreement* as interpreted by Landis and Koch (1977). The interrater reliability for the raters was $Kappa = 0.71$ ($p < .001$), 95% CI [0.688, 0.739].

Missing Data

Data from one participant were excluded from the analyses because the interview was not fully recorded due to a full memory card. One other participant failed to provide her age; however, all other data were recorded for this individual; therefore, this participant was kept in the analysis.

Assumption Tests

A Kolmogorov-Smirnov test was conducted on all variables of interest to test for the assumption of normal distribution. All dependant variables violated this assumption with significant p -values. A Levene's test for homogeneity of variance also revealed that the variances were significantly different between these variables⁶. To correct for these violations, the positively skewed variables (response time, blinking, blink flurries, eye closures, speech disturbances, eye contact, and manipulations) were transformed using a

⁶ Preliminary data analysis was conducted prior to transforming the data. The presence of numerous outliers and the extreme skewedness of the data prompted the decision to Log transform all the variables as outlined in Field (2009).

Log transformation [$\log(X_i + 1)$]. Negatively skewed variables (pauses and illustrators) were reverse score transformed before applying the log transformation. Transforming the data corrected for violations of normal distribution ($D(100) = .136, p < .001$) and homogeneity of variance ($F(1, 98) = 6.82, p = .01$) in all variables except illustrators⁷. Transforming the data also corrected for participants that were identified as outliers for blinking and response time.

The variables were also coded to reflect the predicted direction of the deception cues when cognitive load was induced. Response length, blinking, blink flurries, eye contact, illustrators, and manipulations were reverse coded to produce a negative number of occurrences, therefore, the smaller the number (farther away from zero), the more often these deception cues occurred. Eye closures, verbal crutches, and pauses in speech were expected to increase with cognitive load induction, therefore, they remained as positive numbers.

Manipulation Check

Each participant was asked four questions immediately after viewing the video stimulus to ensure they watched the video and picked up on specific details of the accident. All of the participants (100%) correctly responded that the accident they “witnessed” involved motor vehicles or was a “hit-and-run”; however, only 91 percent correctly indicated that the accident involved at least two cars. All of the participants

⁷ Parametric tests are generally robust to violations of assumptions; therefore, the decision was made to keep this variable in the analyses because the DV was not extremely skewed and there were equal numbers of subjects in each condition.

(100%) correctly indicated that there were additional witnesses to the accident.

Additionally, 97 percent of participants correctly indicated that the police responded to the accident.

Immediately after their interview, each participant was asked to indicate the manner in which they were asked to lie to the interviewer. Fourteen participants (14%) did not respond to this question and another 4 percent answered the question incorrectly. To ensure these participants' data were still usable for the analysis, their interviews were checked to make sure they complied with their assigned condition. It was found that all participants complied, therefore, no data were excluded based on these results.

Condition Checks and Perceived Task Difficulty

Effects of interviewer. Two volunteers acted as interviewers in the present study. A MANOVA was conducted to ensure there were no individual effects of the interviewer on the presentation and frequency of deception cues. No significant differences were found between interviewer #1 ($n = 58$) and interviewer #2 ($n = 42$) on any of the variables, $F(1,98) = .921, p = .34$ (see Table 1).

Comparisons by condition. Independent samples t-tests were conducted to ensure that there were no effects of condition (omission and falsification) on task performance, self-reports of confidence, and individual perceptions of ability. No significant differences were found by condition for participants' perceived difficulty of the digit memorization task between those in the omission group ($M = 4.56, SD = .91$) and the

falsification group ($M = 4.55$, $SD = .89$), $t(98) = .08$, $p = .93$, 95% CI[-.345, .375]. There were also no differences in participant confidence ratings between omission ($M = 2.55$, $SD = .64$) and falsification ($M = 2.60$, $SD = .72$), $t(98) = -.36$, $p = .76$, 95% CI[-.322, .222]. Participants' perception of their ability to successfully lie to the interviewer also did not differ between omission ($M = 1.94$, $SD = .34$) and falsification ($M = 1.89$, $SD = .41$), $t(96) = .66$, $p = .53$, 95% CI[-.101, .204].

Participant self-report on confidence, difficulty and motivation. Participants were asked to self-report whether they thought they were good liars by placing themselves in one of three categories (not a good liar, somewhat of a good liar, and a very good liar). The majority of the participant sample (60%) reported being “not good liars” and only eight percent reported being very good liars. Most of the participants also reported that they were only “somewhat” confident they were believed by the interviewer (54%), whereas 29 percent reported that they were not confident the interviewer believed their lies. Participants were also asked to report on their level of motivation to appear truthful to the interviewer. Forty-four percent of participants reported being very motivated and 49 percent of participants categorized themselves as “somewhat motivated”.

On a six-point Likert scale that measured difficulty of the tasks, 27 percent of participants reported that it was “somewhat difficult” to lie in the manner they were assigned ($M = 3.98$, $SD = 1.49$) and 22 percent reported that it is “somewhat difficult” for them to lie in general ($M = 4.04$, $SD = 1.46$). When asked whether the digit memorization task was difficult, 61 percent of participants indicated that it was “very difficult” to remember the seven digit number ($M = 5.45$, $SD = 0.83$) and 34 percent reported for each

anchor of “difficult” and “very difficult” to answer the questions while trying to remember the numbers ($M = 4.76$, $SD = 1.29$).

Countermeasures to Deceit

Participants were asked to indicate whether they employed any specific behaviours in order to appear more truthful to the interviewer. The choice of behaviours presented to the participants included tactics that would be in opposition to stereotypical deception behaviours. For example, using increased eye contact as a countermeasure would speak to the deception stereotype that liars avoid eye contact. When behavioural countermeasures were split by lying type, there was a significant difference between the omission ($M = 11$, $SD = .42$) and falsification ($M = 21$, $SD = .50$) groups for those that indicated they used illustrators (using hands and body while talking) as a countermeasure, $F(1, 98) = 4.72$, $p = .03$, $d = .44$. Those in the falsification condition used this countermeasure more frequently. There was also a difference between the omission ($M = 42$, $SD = .37$) and falsification ($M = 30$, $SD = .50$) groups for those that indicated they gave as little detail as possible in their answers as a countermeasure, $F(1, 98) = 7.53$, $p = .007$, $d = .55$. As would be expected, those in the omission condition claimed to use this countermeasure more frequently (Table 2).

Table 1

MANOVA results of potential interviewer effects on deception cues between interviewer #1 (n = 58) and interviewer #2 (n = 42). The analysis revealed there were no significant differences in deception cues based on which individual conducted the interview.

	Interviewer 1		Interviewer 2		[95% CI]	F
	Mean	SD	Mean	SD		
Blinking	.88	.24	.89	.28	.835, .940	0.02
Blink flurry	.28	.33	.25	.35	.201, .339	0.29
Eye closure	.08	.16	.12	.21	.067, .142	1.63
Verbal crutch	.41	.19	.43	.20	.383, .464	0.39
Pauses	.18	.14	.19	.15	.159, .219	0.31
Illustrators	.40	.33	.39	.31	.336, .468	0.05
Manipulations	.41	.20	.45	.23	.391, .479	0.54
Eye contact	.52	.18	.48	.16	.469, .541	1.65
Response Length	1.10	.22	1.15	.23	1.08, 1.18	1.15

Table 2

One way ANOVA results of participants' (N = 100) self-reported interrogative countermeasures used during interviews reported for each group (falsification and omission). Percentages indicate the proportion of participants that reported they employed the tactic.

Countermeasure	Omission (n = 50)		Falsification (n = 50)		F	d
	M	SD	M	SD		
Increased eye contact	48	.50	46	.49	0.03	
Used hands and body while talking	22	.41	42	.49	4.72*	.44
Decreased eye contact	28	.45	22	.41	0.47	
Smiled	46	.50	54	.50	0.63	
Used pauses to appear like thinking	70	.46	64	.48	0.40	
Gave as little detail as possible	84	.37	60	.49	7.53**	.55
Tried to remain as still as possible	38	.49	32	.47	0.38	
Reduced smiling to appear serious	38	.49	30	.46	0.70	
Used facial expressions & body language you associate with truthfulness	26	.50	26	.44	0.00	
Tried to control body movements	46	.50	34	.47	1.49	
Appeared disinterested	18	.38	12	.32	0.69	
Tried to control nervousness	58	.49	72	.45	2.15	
Included as much detail as possible	4	.19	14	.35	3.08	
Answered the questions as quickly as possible	54	.50	42	.49	1.43	

*Note: * = $p < .05$, ** = $p < .01$*

Chi Square analyses were conducted to determine any differences between the countermeasures the participants claimed to have used and the behaviours that were actually observed during the interviews. The percentage of participants who claimed to

use their hands and body while talking (32%) was different than those who were observed using illustrators during their interview (55%), $X^2(1, N=100) = 7.60, p = .006, d = .57$.

However, there was no difference between the number of participants that claimed to use pauses in speech to appear truthful (67%) and those who were observed using pauses (85%), $X^2(1, N=100) = .391, p = .53$. There were also no significant differences between participants who claimed to use decreased eye contact (25%) compared to overall eye contact observed, $X^2(1, N=100) = 32.96, p = .51$, or increased eye contact (47%) compared to overall eye contact, $X^2(1, N=100) = 31.08, p = .61$.

Symptoms of Nervousness

Participants were given a list of common physiological symptoms of nervousness and anxiety, and asked to report if they experienced any of them during the interview. There were no significant differences for symptomology between those in the falsification condition and participants in the omission condition. Groups were further analyzed by gender; however, no significant differences were observed (see Table 3).

Table 3

Independent samples t-test results of anxiety symptoms analyzed by condition (omission and falsification) and gender. There were no significant differences identified between groups or by gender.

Anxiety Symptoms	Omission (n = 50)					Falsification (n = 50)				
	Male (n = 28)		Female (n = 22)		t	Male (n = 14)		Female (n = 36)		t
	M	SD	M	SD		M	SD	M	SD	
Sweating or Clamminess	3.0	.35	8.1	.46	1.30	0.9	.26	14.0	.49	2.91
Fast heartbeat	5.0	.42	7.0	.44	0.18	1.9	.36	14.0	.49	1.93
Tightening of chest	1.9	.29	3.9	.35	0.55	0.9	.26	6.8	.40	1.25
Shortness of breath	0.0	0	0.0	0	0	0.9	.26	5.0	.35	0.64
Difficulty thinking clearly	12.1	.51	17.9	.48	0.68	6.0	.51	24.8	.46	1.75
Stuttering/ Tripping over words	3.9	.39	8.9	.47	1.13	1.9	.36	11.8	.47	1.51
Fluttery feeling in stomach	1.1	.21	8.1	.46	2.44	0.0	0	11.8	.47	4.18
Indigestion	0.0	0	0	0	0	0.0	0	0.0	0	0
Feelings of defensiveness	1.9	.29	1.9	.26	-0.24	0.9	.26	5.0	.35	0.64
Feeling like you wanted to run away	1.1	.21	5.8	.41	1.80	0.9	.26	6.1	.37	0.86

*Note: * = $p \leq .006$,*

Main Analyses

A mixed-design ANOVA was used to test the main hypotheses. Deception cues observed with cognitive load induced and cues observed when cognitive load was not induced served as the within-subjects factor and lying type was the between-subjects factor. To control for family-wise Type I error, alpha levels were adjusted to $\alpha = .006^8$. The analysis did not reveal a significant main effect of cognitive load on the sum of all deception cues that were observed for each response over the course of the interview⁹, $F(1,98) = 1.00, p = .319$. There were no differences between the number of indicators of deception in the non-cognitive load condition ($M = -2.84, SD = 0.87$) as opposed to the cognitive load condition ($M = -2.77, SD = 0.99$). A main effect of lying type on deception cues was significant $F(1,98) = 10.11, p = .002, d = .64$ with the falsification condition ($M = -3.08, SD = 0.12$) producing more deception cues than omission ($M = -2.53, SD = 0.12$). The analyses also determined there was a non-significant interaction of falsification and cognitive load on deception cues, $F(1,98) = 0.01, p = .92$ (see Figure 1).

Independent samples t- tests were conducted to further investigate the significant difference between falsification ($M = -0.80, SD = 0.81$) and omission ($M = -0.52, SD = 0.54$) for overall deception cues ($\alpha = .05$), $t(98) = 2.09, p = .04, d = .42, 95\% CI[0.014, -0.561]$. When each deception cue was analyzed individually between conditions of lying type, and regardless of cognitive load induction, the mean number of verbal crutches was trending with alpha set at $\alpha = .006$, between the falsification condition ($M = .47, SD =$

⁸ Adjustments were made by dividing standard alpha ($p = .05$) by the number of dependant variables analyzed (DV = 9).

⁹ Overall deception cues were also log transformed to maintain consistency within the analysis.

0.21) and the omission condition ($M = .36, SD = 0.17$), $t(98) = -2.68, p = .008, d = .54$, 95% CI[-0.182, -0.027]. Although this is not a significant result, it does indicate that

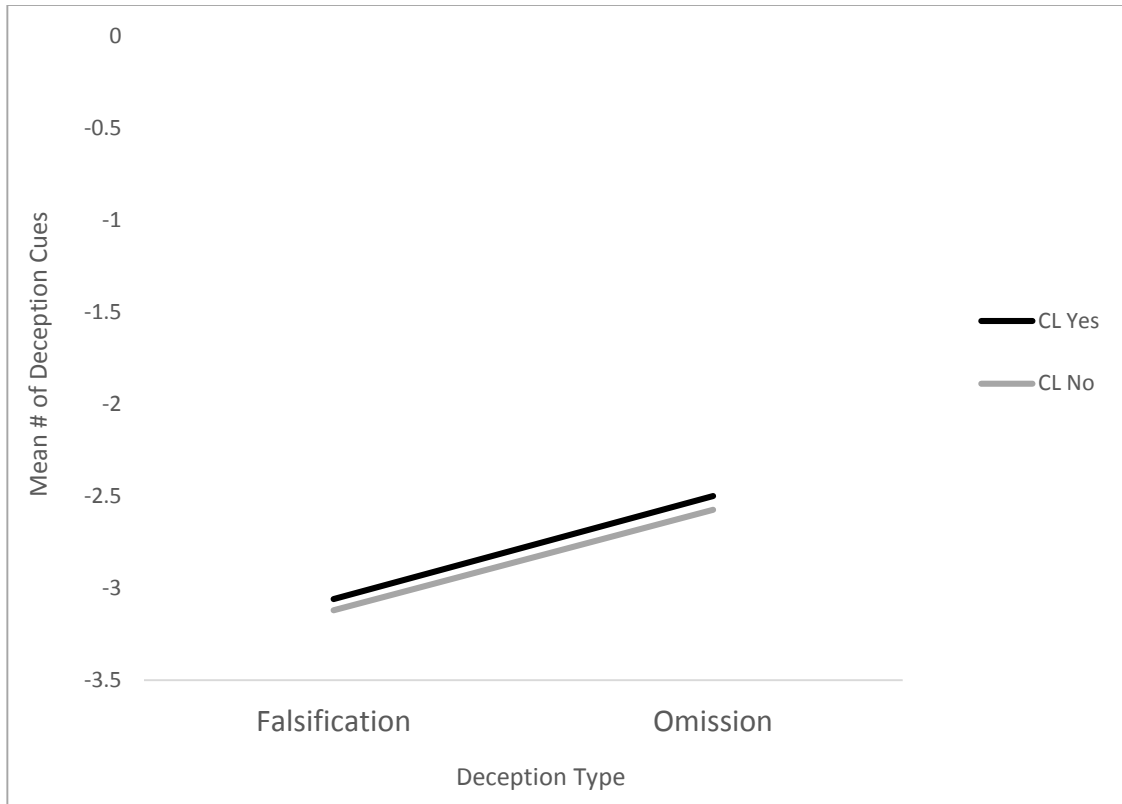


Figure 1. Main effects and interactions. There is no significant main effect of cognitive load; however, there is a significant main effect of lying type. The interaction effect between cognitive load and falsification is also non-significant.

the verbal crutch behavioural cue is moving in the predicted direction. Furthermore, the number of illustrators used in the falsification condition ($M = -0.53, SD = 0.35$) were significantly higher than in the omission condition ($M = -0.27, SD = 0.23$), $t(98) = 4.41, p < .001, d = .89, 95\% CI[0.146, 0.384]$. Additionally, the length of responses were also

significantly longer in the falsification condition ($M = 1.20$, $SD = 0.23$) compared to the omission condition ($M = 1.05$, $SD = 0.19$), $t(98) = -3.32$, $p = .001$, $d = .67$, 95% CI[-0.230, -0.058]. None of the other deception cues of interest were significantly different between conditions (see Table 4).

Table 4

Independent samples t-test results for the effect of deception type (omission and falsification) on individual and overall deception cues. Effect sizes reported for significant p-values only.

Deception Cue	Omission		Falsification		<i>t</i>	<i>d</i>
	Mean	<i>SD</i>	Mean	<i>SD</i>		
Response Length	1.05	0.19	1.20	0.23	-3.32**	.67
Blinking	-0.84	0.22	-0.92	0.28	-1.47	
Blink Flurry	-0.23	0.31	-0.30	0.36	-1.02	
Eye Closure	0.10	0.18	0.10	0.19	0.15	
Verbal Crutches	0.36	0.17	0.47	0.21	-2.45	
Pauses	0.19	0.14	0.17	0.15	0.54	
Illustrators	-0.27	0.23	-0.53	0.35	-4.41**	.89
Manipulations	-0.40	0.18	-0.45	0.25	-1.12	
Eye Contact	-0.47	0.14	-0.53	0.20	-1.68	
Overall Deception Cues	-0.52	0.53	-0.80	0.80	2.09*	.42

Note: * = $p < .05$, ** = $p < .006$

A paired samples *t*-test was used to determine if there were within-subject differences in deception cues when cognitive load was applied and when it was not (see Table 5). Alpha levels at $\alpha = .05$ were used to determine significance. The analyses revealed differences in blink rate when cognitive load was applied ($M = .82, SD = .26$) and when it was not applied ($M = .85, SD = .23$), $t(99) = -2.02, p = .04, d = .40, 95\% CI [-.001, .062]$, with blinking appearing more frequently in the non-cognitive load condition. Eye contact also showed within-subject differences when cognitive load was applied ($M = .48, SD = .20$) and when it was not applied ($M = .51, SD = .19$) with more eye contact being made in the non-cognitive load conditions, $t(99) = -1.93, p = .05, d = .38, 95\% CI [-.001, .068]$.

Table 5

Results of a paired samples t-test to determine within-subject differences between questions asked with cognitive load induced and questions asked with no cognitive load induction.

Deception Cues	Cognitive Load		No Cognitive Load		<i>t</i>	[95% CI]
	Mean	<i>SD</i>	Mean	<i>SD</i>		
Response length	-1.12	.26	-1.12	.23	0.34	-.044, .030
Blinking	-0.82	.26	-0.85	.23	-2.02*	.001, .062
Blink flurry	-0.16	.26	-0.18	.24	-1.52	-.007, -.056
Eye closure	0.04	.11	0.06	.14	-1.20	-.041, .010
Verbal crutch	0.40	.24	0.43	.21	-1.52	-.064, .008
Pauses	0.16	.19	0.19	.18	-1.76	-.071, .004
Illustrators	-0.37	.36	-0.41	.25	-1.62	-.008, .086
Manipulations	-0.41	.25	-0.43	.23	-1.48	-.007, .054
Eye contact	-0.48	.20	-0.51	.19	-1.93*	-.001, .068

*Note: * = $p < .05$*

Discussion

The primary purpose of this research was to explore the effects of cognitive load and lying type on deception cues. Both stereotypical deception cues (i.e., manipulations and the amount of eye contact) and deception cues that have shown some reliability in the literature (i.e., illustrators, speech disturbances, pauses and blinking) were investigated. Overall, the results of the present study found that Hypothesis 1 was not supported as there were no main effects of cognitive load on the deception cues. However, differences were found at the individual level (within-subjects) when cues in the non-cognitive load responses were compared to cues in the cognitive load induced responses. Hypothesis 2 was supported as there were main effects of deception type on deception cues, with the falsification group producing more indicators of deception overall. Hypothesis 3 was not supported because deception type and cognitive load induction did not interact.

Effects of Cognitive Load

The lack of a main effect for cognitive load on deception cues is somewhat surprising. I don't believe this is an indication that the cognitive load induction did not work; however, I do believe it speaks to how and when extraneous cognitive load was applied during the interview. The cognitive load inductions were counterbalanced across the interviews in an attempt to mitigate the effect of question type. However, by taking this approach, each participant would have experienced the effects of extraneous load from the first induction to the last question. This also means that the effects of the cognitive load induction would have been present for all questions when collapsed across

participants. In hindsight, this was not the ideal interview design because it may have eliminated the “no cognitive load applied” condition between subjects due to the additive effects of cognitive load (Paas et al., 2003).

When the outcome variables were examined within-subjects, however, there was a significant reduction in blinking and eye contact in the cognitive load condition compared to the questions where cognitive load was not applied (Bagley & Manelis, 1979; Leal & Vrij, 2008). The reduced amount of blinking when cognitive load was applied indicated that the participant may have needed to think a bit more about their response and may have relied on visualization to recall the video and formulate the lie (Holland & Tarlow, 1975, Vredeveldt et al., 2011). A good way to determine an increase in thought, and thus cognitive load, is to record peaking eye blinks and blink flurries after the lie had been told when additional extraneous cognitive load is applied (Holland & Tarlow, 1972; Leal & Vrij, 2008; Siegle et al., 2008). The increased blinking behaviour is thought to be an automatic response to help alleviate some of the stress on the working memory. Unfortunately this peaking behaviour was not analyzed in this study; however, incorporating this analysis into future studies may be another way to judge the effectiveness of the cognitive load induction technique.

Closing the eye is also known to be an effective way of lessening mental load; therefore, eye closures were expected to be more prevalent when cognitive load was applied (Vredeveldt et al., 2011). The lack of significance for eye closures within-subjects was unanticipated for the present study; however, this finding may be explained by

significant increase of broken eye contact in the cognitive load condition. The levels of cognitive load were most likely not large enough to cause participants to close the eye to alleviate the effects of the extraneous cognitive load. However, participants may have chosen to break eye contact instead, which is still a method of alleviating load (Siegle et al., 2008; Vrij et al., 2010). Gaze aversion has long been thought to be an indicator of deceit, but for the wrong reasons. Liars are not averting the eyes out of shame or guilt, but because it is easier to formulate the lie in high load situations if attention and cognitive resources not allocated to visual communication (Doherty-Sneddon et al., 2001; Doherty-Sneddon & Phelps, 2005).

Although the cognitive load induction was strong enough to reveal a moderate effect on some behaviours, and in the predicted direction, the lack of significant finding for other indicators of deception was somewhat surprising. For example, verbal crutches and pauses were expected to be more prevalent when cognitive load was applied due to the effects of load on cognitive processing. This expectation was based on the assumption that the individual would access socially acceptable and plausible responses through the working memory, and they would have filled the gaps in their speech with “umms” and “ahhs” while their thoughts caught up with what they were saying (Arciuli et al, 2010; Leins et al., 2012; Vrij et al., 2011). For this reason, response length was also expected to be longer when cognitive load was induced because the verbal crutches and pauses would have increased speaking time. Unfortunately, participants’ individual working memory capacity was not taken into account during this study; therefore, the strength of

extraneous load needed to ensure the working memory was sufficiently taxed remains unknown.

Effects of Deception Type and Falsification

As predicted there was a main effect of deception type on deception cues regardless of cognitive load induction. This is a novel and important finding in deception research because it specifies the type of deception that creates the cues we may use to detect deceit. The analysis in this study clearly shows that falsification is the driving factor for the behavioural differences observed in lying type. This finding was expected within the context of a study that examined lying through a cognitive lens; however, it was surprising that falsification did not produce the same differences in behavioural cues as cognitive load. In theory, the very act of falsification should apply additional load to the working memory. One possible explanation is that when an individual is falsifying, the level of cognitive load is not high enough to create the cues we see (e.g., less blinking and reduced eye contact) when cognitive load is high.

When lying type was analyzed independent of cognitive load induction, illustrators and response length emerged as the most prominent cues in the falsification condition. Increased illustrators may indicate something novel about the act of falsifying because moving the hands when communicating is useful when trying to find a word or trying to describe something (Rauscher, Krauss & Chen, 1996). For example, although the process of fabricating a story may not be strong enough to mitigate blinking, the increased load may induce a need to move the hands more while talking. Previous

research has shown that using the hands while talking changes blood flow to different regions of the brain during fMRI studies. In these neurocognitive studies, talking with the hands can be used as a deception detection countermeasure (Davatzikos et al., 2005; Langleben & Moariarty, 2013). Therefore, moving the hands when searching for a word may also be indicative of combatting the additional cognitive load that occurs when making up details.

Furthermore, significantly more participants (49%) reported using their hands when talking to appear more truthful in the falsification condition. These participants believed that being more expressive with the hands was a good way to look more truthful to the interviewer (counter-stereotypical behaviour; GDRT, 2003). This conscious behaviour could also be the reason more illustrators were observed in falsification; however, further analysis revealed that significantly more participants were observed using illustrators than those who reported doing so purposefully. This may indicate that using illustrators when falsifying is more automatic than deliberate. This finding certainly warrants further investigation as illustrators have previously shown some promise in the literature as a potentially reliable deception cue (DePaulo et al., 2003; Klaver et al., 2007).

The presence of increased illustrators in the falsification condition, regardless of cognitive load induction, could also indicate that the cognitive load induction technique was not as effective as anticipated. Previous studies have found that high levels of cognitive load generally produced an unnatural stillness in an interviewee (rigidity effect;

Mann et al., 2002; Vrij & Mann, 2001). In the present study, participants were observed making numerous bodily movements, and some even reported making certain movements deliberately. This finding seems at odds with the presence of behaviours indicative of high levels of cognitive load (i.e., less blinking and less eye contact). Additionally, the lack of significant interaction effects between cognitive load and deception type may indicate that inducing cognitive load did not assist in the differentiation of behaviours that occurred during a specific type of deception. One possible explanation again points to the levels of cognitive load not being high enough to produce all the predicted outcomes or perhaps it was not strong enough to tax the working memory of all the participants.

Cognitive Load Induction Technique

The findings in the present study appear to support the notion that large amounts of extraneous load need to be applied in order to tax the working memory to the point that cognitive load induction techniques work for all participants (Hollard & Tarlow, 1975; Paas et al., 2003). Holland and Tarlow (1975) have previously demonstrated that *how* cognitive load is induced is not as important as the strength of the induction. Thus, the digit memorization task utilized in this study may not have been strong enough to elicit certain cues. Previous research has also demonstrated that two factors must be present for the cognitive load induction approach to be effective as a lie detection tool: the ability to recall the event, and the motivation to be believed (Vrij et al., 2008). Although the majority of participants responded correctly when asked about details of the video, it is unknown if they were actively recalling these details. In fact, the lack of saliency for the

event (i.e., hit and run video, no real relationship with the driver) may have hindered the interaction effects of cognitive load and lying type. That is, the participants did not have to sort through the memories and associated emotions of the event to make up a plausible story or omit vital details. In the present study, participants had to simply recall what they saw and either say something different or leave out information.

In regards to motivation, it was thought that enticing the participants with the ability to win a \$50 gift card of their choosing would be enough incentive to produce the desired level of motivation to be believed. Most participants reported a level of motivation that indicated they were only somewhat motivated to be believed by the interviewer. One could argue this may have been due to the low-stakes or low-consequence design of this study. Although there is literature that suggests the consequences of being caught in a lie play an important role, Vrij and Granhag (2012) offer compelling arguments that motivation affects behaviours in liars and truth-tellers alike. This argument was also supported in findings by the National Research Council (2003); therefore, I would suggest that future research employ study designs that increase motivation in the participants and include a truth-telling condition for comparison.

Participants not only need to be motivated, but they must have also been able and willing to remember the numbers for the induction to work (Engle, 2002; Miller, 1956). In the present study, participants were led to believe that correctly reciting the seven-digit sequence would win them additional ballots to the gift card. However, their motivation or ability to remember the numbers was not measured, and thus remains unknown. We do

know that items not encoded into the long or short-term memory are generally lost in the working memory within 20-seconds (Engle, 2002); therefore, it is likely that participants could have engaged in cognitive inhibition when focusing on the question and did not attempt to retain the seven-digit number (MacLeod, 2007; Sweller, 1988). It should be noted that only two participants were able to recite back at least the first two of the seven digit sequences, and no participants could recite back all three sequences. While digit memorization and mathematical problems may be an effective way to induce extraneous cognitive load as a secondary task, in certain circumstances, real world applications would be difficult.

Practical Implications

Although the current study may not be immediately generalizable to an interrogative situation, the findings provide additional support for possible deception cues that have been previously identified in the literature as showing some promise of reliability. When there were differences found (i.e., between cognitive load induction and no induction, and between deception type) the effect sizes were generally moderate ($d = .38 - .67$) and even large in the case of illustrators used in falsification versus omission ($d = .89$). These findings may indicate that when a difference exists, it is large enough to be detected; however, a cautionary note is needed. These findings do not indicate reliability of any indicators of deception (i.e., eye blinks, eye contact, illustrators), nor do they suggest they can be applied to individuals. Before reliability can be assessed, these findings would need to be replicated with a stronger and more realistic cognitive load

induction technique. Additionally, before any deception detection technique could be implemented, it would need to be empirically tested with both naive and trained judges to see if deception can be reliably detected.

Moreover, neurocognitive findings have demonstrated that deception detection in individuals may not actually be the answer (Davatzikos et al., 2005; Lui & Rosenfeld, 2008). Although fMRI studies have shown that truth and lies can be discriminated (Spence, 2004; Abe et al., 2008), and some accurate markers can be generalized across individuals (Monteleone et al., 2009), even the neurological and cognitive based deception detection techniques are still vulnerable to countermeasures and individual differences (Ganis & Keenan, 2009; Gombos, 2006; Langleben & Moariarty, 2013). For example, the excessive use of illustrators when falsifying would confound the results of neuroimaging techniques, and the lack of deception indicators when omitting would make detecting this type of deceit very difficult for investigators during interviews.

The present study did answer some questions about lying type and how it may influence certain behaviours. For example, there is evidence that lying by falsification seems to be the driving factor behind the presentation of specific deception cues. This finding is important for researchers and law enforcement interviewers because it indicates that lying in a particular way is more likely to have an effect on the presentation of certain cues. Although suspects who are being interrogated may be inclined to lie more by falsification in order to remove themselves from the details of the crime, hostile witnesses and victims may tend to lie more by omission since some knowledge of the events are

expected from them. Additionally, deceiving by falsification or fabrication may feel more like lying and thus, people will behave like they are lying, whereas omission involves telling some of the truth while leaving out incriminating or important details; therefore, it presents more like truth-telling. This means that people may behave like they are telling the truth when omitting, which would be difficult to detect (Zuckerman et al., 1981).

The present study also highlights how certain variables may affect the saliency of deception cues and the accuracy in judgements of statement veracity. Estimator variables are the individual differences that occur between interviewees that may interfere with an interviewer's ability to detect deception cues¹⁰. For example, cultural differences between the interviewer and interviewee may create some difficulty in deception detection because relying on eye contact could prove to be problematic when dealing with people who were raised in cultures where looking an authority figure in the eye is seen as defiance and disrespect (Castillo & Mallard, 2011). Similarly, people who culturally use their hand excessively while talking, and are prone to giving lots of detail, may also be incorrectly identified as liars if illustrators and response length are used as indicators (Rauscher et al., 1996). This becomes a problem when an interviewer incorrectly identifies these cultural behaviours as deception, which may result in longer interviews and increase the likelihood of a false confession (Kassin, 2005, 2012; Leo, 1996; Perillo & Kassin, 2011). This is where relying on cognitive cues as opposed to stereotypical cues may assist interviewers in picking up on indicators of deceit.

¹⁰ The terms estimator and system variables occur almost exclusively in the eyewitness literature; however, they have some relevance here to describe the types of challenges faced by deception detection researchers and professionals.

Furthermore, establishing a baseline of behaviour before inducing cognitive load may also help reduce some of the issues associated with individual differences. Observing the interviewee's behaviour during rapport building and prior to cognitive load inductions or questioning allows the interviewer to see when the behaviour changes during the course of the interview. That is, increases and decreases in behaviour can be spotted by trained investigators because inducing cognitive load is suspected to mitigate individual behavioural differences and amplify indicators of deceit which are not easily controlled (e.g., blink rate and speech disturbances; Holland & Tarlow, 1972; Leal & Vrij, 2008; Siegle et al., 2008).

Although cognitive load inducing techniques may hold some answers to reliable deception cues, they have not been tested cross-culturally, nor have they been tested on vulnerable populations (e.g., developmentally delayed, mentally ill, youth, or highly suggestible persons). These special populations need to be considered when creating lie detection tools because many of the techniques used in the past and present have elicited false confessions and have created false memories in these types of suspects (Kassin, 1997; Kassin et al., 2009; King & Snook, 2009). Additionally, cognitive load inducing techniques have not been tested on interviewees that genuinely believe their stories. This may occur as something that naturally happens within the individual, or it could be employed as a countermeasure. However, if the suspect or interviewee has created a false memory of the event, is this actually deceit? I suspect many researchers would acknowledge that delusion or false memory recall is not in fact deceit as it is generally defined in deception studies (DePaulo et al., 2003; Ekman, 2009; Vrij & Granhag, 2012;

Walczyk et al., 2013), this phenomenon is important to keep in mind, however, as it can affect the outcome of an interrogative interview.

System variables are those factors that exist due to the very nature of the deception detection technique used, or due to the processes that exist within the justice system. For example, previous research has repeatedly shown that employing traditional deception detection techniques (e.g., behavioural interviewing, polygraph, gut instinct) can elicit cues that are indicative of nervousness and anxiety, which are incorrectly identified as deception cues (APA, 2004; Bond & DePaulo, 2008; DePaulo et al., 2003). Although inducing cognitive load may be an effective way to elicit cues that are not based in anxiety, the present study shows that this technique is not a fool proof way to generate reliable deception cues. In the present study, low level cognitive load induction did not amplify the saliency of all predicted deception cues; therefore, in a real world application, the interviewee's deception may have gone undetected. In fact, only some cues were elicited and were detectable only when the interviewee's behaviour was compared with and without cognitive load induction (within-subject). Therefore, the challenge for researchers going forward will be to identify whether cognitively taxing thresholds can be generalizable to the populace (i.e., one induction technique that will tax the working memory sufficiently in all interviewees), or if it is an individual trait that must be established for each interviewee.

Overall, the most practical implication of the present study is understanding how cognitive load may influence lying behaviours. This may be important when choosing an

interrogation or questioning technique. Being able to identify when a suspect is cognitively taxed may present a good opportunity for police interviewers to apply a more cognitively taxing interrogation technique to amplify the saliency of deception cues or to even mitigate the opportunity to lie. For example, Vrij and Fisher (2008) reported that American investigators disclosed through anecdotal evidence that the reverse order technique is very effective in exposing non-credible and inconsistent stories in interrogation situations. Additionally, Vrij et al. (2009) demonstrated that the unanticipated question immediately induces cognitive load making it easier to detect deceit through various cues such as speech disturbances. This means that if the suspect is showing evidence of experiencing high load, using one of these interview types may optimize the situation and allow the interviewer to quickly get to the truth.

These more cognitively taxing interview tactics may also be more effective when used in conjunction with investigative interview techniques like the PEACE model. For example, having a suspect give an account of events in reverse chronological order should reduce the ability to falsify while the interviewer still adheres to the principles of planning/preparation, engaging/explaining, accounting, obtaining closure, and evaluating the information. Furthermore, the investigative approach of the PEACE model could counter any attempts at omission by allowing the interviewer to prod for more information in a non-adversarial manner. This feature of the combined techniques would also make it a suitable interview style for suspects, witnesses, and victims.

Cognitive load techniques could also be effective for non-behavioural indicators of truth or deceit. For example, verbal credibility assessment has shown better than chance accuracy in discriminating between truth and lies regarding witness and victim statements (Griesel, Ternes, Schraml, Cooper & Yuille, 2013). However, this technique has not shown the same success when used to assess suspect statements. This may be due to credibility assessment being better at ascertaining the truth than detecting lies, or it may speak to the type of interview used in suspect interrogations. That is, credibility assessment is only as good as the interview used to elicit the statement, and can sometimes be hindered by a truth-bias (i.e., false-positives that the statement is true; Griesel et al., 2013). Using cognitive load induction techniques for suspect interviews that will be later subjected to credibility assessment may help in amplifying deception cues, particularly verbal cues. This could lessen the number of statements that appear truthful and assist investigators in veracity judgements.

Limitations & Future Research

As with all empirical research, there is the opportunity to identify some limitations that warrant attention. First, the study design does not effectively mirror a situation where an investigator or police interviewer would assess the veracity of responses. In fact, no deception judgements were made to determine whether a judge, naïve to condition, could ascertain whether deception was taking place. When planning the present study, it was determined that a controlled experimental design would be needed in order to understand the effects of lying type on deception cues. Although this approach has yielded some

interesting findings, future studies of this nature would benefit from creating a more generalizable interrogation scenario. For example, interviewers do not generally sit passively and listen to a suspect's responses and move onto the next question without some type of engagement. In an interrogative interview, officers would challenge the suspect's answers or ask for more detail. Additionally, the interviewer's own body language and responses to the suspect may play a role in eliciting genuine cues to deception by increasing the cognitive demands through their interaction with the suspect.

Second, the participants in this study did not actually witness a crime take place, nor were they attempting to protect a good friend from the police (as insinuated in the interview instructions). The lack of saliency for the events they were instructed to lie about may have affected the presentation of their deceptive behaviours. In fact, some of the extraneous cognitive load that occurs in real-life interrogative circumstances may stem from the act of actually being questioned by police and the high pressure of the situation.

Finally, one of the main challenges with laboratory studies remains the ability to generalize or use the findings in real world applications. As previously mentioned, there is a possibility that the method used to induce cognitive load in this study was not strong enough to produce the expected outcomes (Paas et al., 2003). It is also possible that the participants did not attend to the video stimulus or the memorization task enough to increase the amount of extraneous load needed to detect the differences between the two cognitive load conditions (Barrouillet et al., 2007; Paas et al., 2003). If this is a challenge

in a laboratory setting, it could certainly pose some problems in real-world interrogation situations - especially when interviewing suspects. Although the method used to induce cognitive load may have no effect in purely cognitive research (Holland & Tarlow, 1975), it may be paramount in applied forensic and investigative situations.

A more effective way to induce cognitive load in interviews may be to use a technique where the interviewees' motivation, or ability to memorize, is not a factor. Vrij et al. (2010) outlined four effective ways to induce cognitive load in an interview: strategic use of evidence (SUE; Hartwig et al., 2006, Tekin et al., 2015), unanticipated questions, reverse chronological order, and forced eye-contact. Each of these techniques is designed to induce cognitive load by the very act of taking part in the interview and answering the questions and may have added some generalizability to the findings.

Conclusions

Although the findings in this study did not provide outright support the use of cognitive load as an effective tool to detect deception in interrogations, there is previous research that provides convincing evidence that inducing cognitive load in specific ways may be a useful technique. The challenge for researchers is to find ethical and effective ways to induce high levels of cognitive load during interviews, as well as find ways to measure any possible cues to deception (i.e., blinking, decreased eye contact, or increased hand movements when falsifying). A note of caution is necessary, however, as the findings here do not guarantee any of these behaviours as reliable deception cues. Rather, the study lends support for further research in this area.

It is also important to mention that these findings may serve to add another level of complexity to deception detection research where specific deception cues are sought. That is, it may be worth further study to determine if the cognitive processes needed to lie by omission are impervious to the effects of cognitive load. It is possible that this is the case since omitting involves telling part of the truth, and this may have an effect on the saliency of cues overall. Deception detection studies have commonly defined deception as the act of intentionally concealing or falsifying information; however, many people use a mixture of both falsification and omission when lying. If it is falsification that drives the deceptive behaviours, researchers should exercise caution when creating experimental designs so they do not prompt the individual to use one type of lying more frequently than the other (unless this is the effect they are looking for). This finding also suggests that if an individual deceives by omission alone, they are less likely to give off observable and salient deception cues. This means that the absence or reduction of these cues does not indicate the absence of deception and this should also be taken into consideration when designing deception detection tools and techniques.

Finally, the knowledge that lying type can influence deception cues may also provide more support for deception detection and interview techniques that do not rely on lying. Techniques that are structured to reduce the opportunity for a suspect to lie may be the more realistic direction for law enforcement to take (e.g., SUE technique) since specific deception detection cues remain elusive. However, combining techniques that use cognitive processes and investigative interviewing to elicit reliable cues may be the better

option for interview questioning that requires the use of closed and open ended questions (e.g., interviewing witnesses and victims).

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Appendix A

Operational Definitions of Behavioural Cues & Coding Guide

These are the operational definitions for the interview behaviours

Behaviour	Definition
Blink	A blink is full closure of both eyes for less than one second. If only one eye closes, this is a WINK and should be recorded in the notes section with question number and frequency of winks.
Blink Flurry	A rapid succession of two or more blinks where the eyes fully close and open for less than 1 second in total. If this occurs with only one eye, it is a TWITCH and should be recorded in the notes section with question number and frequency.
Eye-closure	Lids completely drawn together for more than 1 second. No sclera, iris or pupil is visible.
Verbal Crutches	Inarticulate sounds made throughout a statement that include, “aahs, umm, err, hrrmmm, or holding a words longer than natural (e.g., Soooooo, welllll, etc.).
Pauses	Periods of silence for more than 2 seconds. Can occur at the end of a statement and prior to the next statement or mid-statement. If there are inarticulate sounds being made, see VERBAL CRUTCH.
Self-manipulations	Touching some part of the body. Examples: <ul style="list-style-type: none"> • Clasping hands, tapping fingers, crossed arms, rubbing arms and/or legs, • Fidgeting (movement in the hips, buttocks, back, ribs) • Touches Face – Includes touching any area above the lower jaw and below the natural hairline on the forehead. Does not include hair, ears. • Touches head – Includes neck, ears, hair and area from natural hairline and back to base of neck.
Illustrators	Using the hands to illustrate, gesture, or emphasize a point while talking <ul style="list-style-type: none"> • Uses hands while talking - Moving hands and arms to accentuate verbal responses. Leaning forward or away to accentuate a point.
Body Movements	If the participant remains extremely still and rigid for the entire response, mark as an occurrence. If the participant remains still except for small manipulations, mark in the notes section.
Response length	Time point the participant utters their first sound to the time point they stop speaking and make no further verbal sounds.

Verbal Communication and Story-telling Score Sheet

Rater Name: _____ Date: _____

Participant ID#: _____ Video ID: _____

Blink Rate

- Tally each time you see the participant blink within that time frame. Note that blinks and blink flurries are recorded separately (see code sheet for definition).

Duration of the Video	Blinks Tally	Total	Blink Flurries Tally	Total	Eye Closure Tally	Total

Speech Disturbances

- Tally for each type of speech disturbance observed. See code sheet for definitions.
- Score for amount of detail (see code sheet for rubric)

Category	
Response Length	
Verbal Crutch (Um, ah, er, hrm)	
Total	
Pauses	
Total	

Note:

Category	Tally	Duration	Notes
Manipulations			
Illustrators			
No body movement			

Appendix B

Type your responses in the text box:

1. What type of accident did you witness? _____
2. Approximately how many people were involved in the scene you just witnessed?

3. Did the police respond? Yes ____ No_____
4. Did all the people in the accident wait for the police to arrive? Yes ____ No_____
5. Were there other witnesses to the accident besides yourself? Yes ____ No_____

Appendix C

How were you asked to lie?

Falsification ____

Omission ____

Please answer the following questions on level of difficulty:

	Very Easy	Easy	Somewhat Easy	Somewhat Difficult	Difficult	Very Difficult
How hard was it to lie in this manner?						
How hard is it to tell lies in general?						
Was it difficult to remember the 7-digit number?						
Was it harder to answer the question while trying to remember the 7-digit number?						

Please answer the following questions:

	Not very	Somewhat	Very
Do you think you are a good liar in everyday life?			
How motivated were you to appear believable today?			
Were you nervous during the interview?			

Please answer the following questions by rating your confidence level:

	Unsure	Not at all	Somewhat	Extremely
How confident were you that the interviewer believed your answers today?				
How confident are you that people believe you when you lie?				

Did you do any of the following things during the interview in order to appear more truthful?

- Increased eye contact
- Used hands and body while talking
- Decreased eye contact
- Smiled
- Used pauses to appear like you were thinking
- Gave as little detail as possible
- Tried to remain as still as possible
- Reduced smiling to appear serious
- Used facial expression and body language associated with truthfulness
- Tried to control any body movements

- Put on a disinterested face
- Tried to control nervousness
- Included as much detail as possible
- Tried to answer the question as quickly as possible before it was asked

Did you have any of the following symptoms during the interview?

- a. Sweating or cold/ damp skin
- b. Fast heartbeat
- c. Tightening of the chest
- d. Shortness of breath
- e. Difficulty thinking clearly
- f. Stuttering or tripping over words
- g. Fluttery feeling in stomach
- h. Indigestion
- i. Feelings of defensiveness
- j. Feeling like you wanted to run away

We all have ways of telling when someone is lying to us. How can you tell when someone you are really familiar with is lying?

Type your response in the box below:

We all have ways of telling when someone is lying to us. How can you tell when someone you don't know really well is lying?

Type your response in the box below:

If you would like to be entered into the draw for the gift card, please provide an email address where we can contact you in the event your name is drawn.

Note: Once the draw has taken place, your email will be deleted. This email will be used for the draw only.

Thank you for taking the time to complete my study. The researcher will now provide you with additional information.

Appendix D

Interview Questions

These questions must be asked in the exact same order and the exact same manner each time. A highlighted number denotes to apply the cognitive load condition to that question.

See *Interview Script* for wording around those questions and protocol.

1. How much of the accident did you witness? Tell me what you saw.
2. Describe the accident scene and the damage to the vehicles.
3. How many other witnesses were there and describe them.
4. How many vehicles were involved in the accident and describe them.
5. We heard one of the people involved behaved oddly. What did they do?
6. Describe the vehicle that left the scene.
7. Where were you last night between 6 -7pm? Describe your activities in detail.

Cognitive load number sequences:

First induction:	6	5	2	8	7	5	1
Second induction:	1	4	9	6	3	7	9
Third induction:	7	2	8	3	4	9	7

Interview directions, questions, and script

Walk into the room and do not say a word to the participant. Go directly to the camera and turn it on. Make sure the participant can be clearly seen and is in focus. Take your seat across from the participant. Make sure you do not smile or make pleasantries. Appear serious and professional, but not disinterested.

Opening script:

- *I'm going to ask you some questions. Please answer them fully and to the best of your ability.*
- Proceed with the first question. If it is a cognitive load question (and for subsequent CL questions), see instructions below.

For cognitive load questions ONLY:

- *Before I ask you the next question I want you to listen to, and remember, the following sequence of numbers because at some point I will ask you to repeat the numbers back to me. If you are correct, I'll give you another ballot for the gift card draw.*

Recite number associated with that question. Wait 3 seconds and then ask the question. Once participant answers, wait 3 seconds and then say:

- *Now please recite back the 7 digit number I just told you.*

Important Notes:

1. Remain stoic and professional for all participants, even if you know them. Consistency is important!
2. You cannot rephrase questions, nor can you repeat them.
3. Do not repeat the number sequence. Say each number with a beat between.
4. Always wait 3-seconds after the participant stops talking before saying anything. This is important for coding.
5. Don't make affirmative/ disapproving sounds, body movements, posture or facial expressions. Sit comfortably in a body neutral pose (we will practice this).
6. Try to look at the participant as much as naturally possible. I want them to have the sense you are trying to figure things out and are paying close attention to their responses. The tricky part will be trying to remain with a neutral face while doing so.

Once the interview is over. Thank the participant. At this point you can smile at them if you like. Tell them they can wait there while you get the researcher. Turn off the camera and leave the room. Make sure the Researcher knows the interview is finished.

Appendix E

Study Script & Procedure

- Greet the participant and direct them to one of the computers
- Ask them to read over the consent form carefully and provide them with a pen. Meanwhile enter the Participant ID, Interviewer ID, and CLA code into Medialab.
- Ask participant if they have any questions about the consent form. Inform them:

This study will investigate how people tell stories based on the things they see and under certain circumstances. Some tasks will be completed on the computer, there will be a short video to watch, a short interview and then some questionnaires to complete. The whole thing should take just under an hour. For your participation today, you will receive 2 bonus points (only if student) and you will be entered into a gift card draw (everyone). Do you have any questions before we start?

- After any questions are addressed, direct their attention to the computer.

Researcher: *Please fill out the following demographic questions. If you have any questions, I'll be sitting over here. Please let me know when you are finished.*

- Once demographics are collected, take them to the next screen and give the following instructions:

You are about to watch a short video involving a hit and run. There are no fatalities, no injuries and nothing shocking in the video. This is the part where you get to use your imagination. Imagine you are sitting at home waiting for a good friend to arrive that you haven't seen in years, so you are attentive to what is happening outside. Suddenly you hear a large crash outside your door. Once the video starts, imagine this is you emerging from your front door and this is the scene that is unfolding in front of you. Pay close attention to the details because this is how you will build your story. There is no sound in the video, so just pay attention to the action. Also, just like in real life, you can only watch the video once. Once the video ends, please let me know. When you are ready, press play.

- Once the video is finished, ask them to fill out the video questionnaire
- Next, give the participant the following information and instruction:

Later on, you learn that the driver who fled the scene was that old friend you were waiting for. You've been identified as a witness to the hit and run, and a police interviewer wants to speak with you. Now you have a challenge, you don't want to get your friend in trouble, but you want to appear cooperative with the police. A "police

interviewer” will be in shortly to ask you some questions, but first we are going to give you a specific way to answer the questions.

- Go to the next page to see what condition the participant has been selected to (Omission or Falsification).
- Read the instructions on the page to the participant. Give them the example of their lying type and ask them to give you a different example. If it is not quite right, explain their lying type again and ask for another example. Continue until the participant understands. When they can give a good example or paraphrase what is needed from them, give them the following information:

The interviewer has never seen this video and it is her job to piece together what happened and what you saw. It’s your job to make it very difficult for her to do that by using (name lying type). There will also be ways for you to win additional ballots to the gift card draw during the interview. When those opportunities arise, the interviewer will let you know. In order to maintain consistency, the interviewer will not repeat anything, nor will she answer any questions you have. Are you ready?

- Direct the participant to the interview chair and adjust the camera angle and zoom as needed. Get the interviewer and leave the room.
- Once the interview is over. Direct the participant back to the computer to complete the study questionnaires.
- Go through the information on the debrief form and allow the participant to ask questions.
- Have them sign second consent form once the study deception has been explained

Appendix F

Consent Form

STUDY TITLE: **The Effects of Communication Styles on Story-telling**

INVESTIGATOR: Nicole Adams, BSc - Saint Mary's University - Department of Psychology
Nicole.adams@smu.ca

SUPERVISOR: Marc Patry, PhD – Saint Mary's University– Department of Psychology
(902)-491-8605 or marc.patry@smu.ca

REB File #: 15 - 074

Introduction

This study is being conducted by Nicole Adams, a student in Psychology at Saint Mary's University for her Master's Thesis in Applied Science. Nicole is supervised on this project by Marc Patry, PhD at Saint Mary's University.

You have been invited to take part in this research study which will examine your communication style and its effects on how you tell stories.

It is up to you to decide whether you want to be in the study or not. In order for you to make an informed decision, you need to understand what this study is for, any risks involved, and any benefits you may receive.

If you decide not to participate in this study, there are no consequences. **You are free to withdraw, or request the removal of your data, at any time prior to June 1th, 2015 by contacting the researcher at Nicole.adams@smu.ca.** After this date, data will be analyzed and findings will be reported. Findings will be reported at the thesis defence and within the thesis document. Findings may also be reported in the form of conference presentations and journal articles.

Participation

Participation should take no longer than 60 minutes. If you agree to participate, you will be given six short tasks to complete:

- Four (4) short computer based questionnaires
- Watch one video
- Take part in a short videotaped interview where you will answer 6 questions about the video you watched.

Risks & Privacy

A study of this nature is described as minimal risk; however, in order for you to make an informed decision to participate, some possible risks have been listed:

- Some people may experience mild feelings of nervousness, stress or anxiety when being videotaped in the interview.
- These feelings may also surface when answering the questions, especially if the questions are difficult, require some thought or are of a personal nature.

If you become uncomfortable or anxious to the point you no longer wish to continue, please inform the researcher and we will stop the study immediately. If your feelings persist and you require additional assistance, please contact Student Counseling Services if you are a SMU student (902-420-5615 or <http://www.smu.ca/administration/counselling/>). If you are not a SMU student, you can contact Mental Health Mobile Crisis Team (902-429-8167 or 1-888-429-8167).

A portion of your participation will be videotaped and analyzed at a later date. These videos are for the purpose of this research only and will not be communicated or shown to outside the data analysis.

Your data will be collected on MediaLab which is research based software. This is simply a database and is not connected to the internet or any other on-line platform. All data will be stored on password protected devices that are accessible only to authorized researchers. All information obtained in this study will be kept strictly confidential. All identifying information (i.e., videotaped interviews) will be stored separately from your questionnaire responses.

Information that is collected during the study will be stored in a secure data base by participant number. Additionally, the results will be pooled as a summary of all people who took part. There is no way, nor any reason, for the researcher to match your name with your participant ID; however, your interview will be matched with your responses for the duration of the study. This means your image will be associated with your responses, but at no time will details about you or your responses be shared with anyone.

The data from this study will be securely stored for up to seven (7) years after the publication of any data. The videotaped interviews will become part of a database that may be used for future research.

Benefits

Participants taking part in this study might not receive any direct benefit; however, what we learn may benefit others.

Upon signing the consent form and agreeing to participate in the study, students who have volunteered through the on-line participation tool (SONA system) will receive one bonus point

toward their grade in the class they have selected. If you have signed up through an approved class, you will receive the number of bonus points specified by your professor/ instructor.

All participants who take part in the study will be entered into a draw for a \$50 gift card (one ballot). As an additional incentive for those who do well on the interview task, they will be entered into an additional draw for another \$50 gift card (two ballots).

If you have any questions about this study, please contact Nicole Adams: nicole.adams@smu.ca, or Dr. Marc Patry: (902)-491-8605, marc.patry@smu.ca. This research has been reviewed and approved by the Saint Mary's University Research Ethics Board, **File # 15-074**. If you have any questions or concerns about this study, you may contact the Chair of the Saint Mary's University Ethics Research Board at ethics@SMU.ca or 902-420-5728.

Signature page

_____ I understand that I will be videotaped during a portion of this study

_____ I understand that I am free to stop the study at any time should I decide I no longer wish to participate.

_____ I understand that I can request the removal of my data any time prior to April 30th, 2015 without penalty (e.g., I get to keep my participation points and ballots).

_____ I understand that I can request my interview be removed from the interview database at any time

_____ I consent for my videotaped interview to be used in future studies of this nature if needed

I understand the information that has been provided to me and I consent to take part in this study.

Participant Signature

Date

Witness Signature

Date

Appendix GDemographic Questionnaire

Sex: Male____ Female_____

Age:_____

Are you currently a student? Yes ____ No_____

If yes:

What type of institution do you currently attend?

 High School (or equivalency program) University Community College Private College (Career College, Business College)*If University:*

What type of program are you attending?

 Undergraduate Graduate

What is your major/ specialty? (e.g., psychology, business, engineering, etc.)_____

Are you currently employed? Yes ____ No_____

If yes:

What is your job title or job type? _____

Appendix H

Debrief Form

STUDY TITLE: **The Effects of Cognitive Load and Lying Type on Deception Cues**

INVESTIGATOR: Nicole Adams, BSc - Saint Mary's University - Department of Psychology –
923 Robie Street, Halifax, NS
nicole.adams@smu.ca

SUPERVISOR: Marc Patry, PhD – Saint Mary's University– Department of Psychology
(902)-491-8605 or marc.patry@smu.ca

REB File #: 15 - 074

Thank you for participating in my study.

I want to let you know that you weren't the only person being deceptive today. The real purpose of my study is to examine how people behave when lying under cognitively taxing conditions. Modern deception detection techniques are rooted in the belief that liars are nervous, feel shame, and give off physiological cues due to an emotionality factor. The problem with this theory is that no one emotion can be used to identify deceit. Aspects of cognitive load theory have been introduced as an alternative lie detection technique (Vrij et al., 2008). Evidence suggests that lying is cognitively taxing; therefore, it increases a deceiver's cognitive demands and should make lying even more difficult.

It is always a difficult decision to not disclose all the information of a study to our participants. I withheld this information from you in the beginning so you wouldn't behave differently during the interview. Withholding the true purpose of this study is the best way to make sure that people behave as naturally as possible under these conditions. For this reason, I ask you not to disclose the true nature of my research to other possible participants.

Please remember that data pertaining to you as an individual participant will be kept confidential. Once all the data are collected and analyzed for this project, the results will be shared during my thesis defense in the summer of 2015 and within my thesis document. I also plan on sharing my findings with the scientific community through conferences, journal publications and presentations.

For your participation today, you have been entered into both of the gift card draws. On Tuesday March 31st, 2015, I will draw two ballots and the winners will receive one of two \$50 gift cards – Good luck!

If you are interested in receiving more information about this study or the results, please contact me at nicole.adams@smu.ca and I will be happy to respond. The study is expected to be completed by April 30th, 2015. As with all research conducted at Saint Mary's University, this study has been reviewed and approved by the Saint Mary's Research Ethics Board (REB File # 15-074). If you have any questions or concerns about this study, you may contact the Chair of the Saint Mary's University Ethics Research Board at ethics@SMU.ca or 902-420-5728.

If you choose to withdraw your data or have any questions about your data, please contact Nicole.adams@smu.ca and quote this participant ID number:

Participant ID #

Debrief Form: Signature page

The Effects of Cognitive Load and Lying Type on Deception Cues

_____ I understand that this study was actually about investigating the effects of lying styles and cognitive load on deception cues

_____ The researcher has allowed me to ask questions and has answered any questions I have at this time.

_____ I understand that I can request the removal of my data any time prior to April 30th, 2015

_____ I understand that I can request my interview be removed from the interview database at any time

_____ I verify consent for my videotaped interview to be used in future studies of this nature if needed

I understand the information that has been provided to me and I verify my consent to the use of my data in this study.

Participant Signature

Date

Witness Signature

Date