DOCTOR OF PHILOSOPHY

Cues to deception in a textual narrative context

lying in written witness statements

Isabel Picornell

2013

Aston University

Aston University

Some pages of this thesis may have been removed for copyright restrictions.

If you have discovered material in AURA which is unlawful e.g. breaches copyright, (either yours or that of a third party) or any other law, including but not limited to those relating to patent, trademark, confidentiality, data protection, obscenity, defamation, libel, then please read our Takedown Policy and contact the service immediately

Cues to Deception in a Textual Narrative Context: Lying in Written Witness Statements

Isabel Carlota Picornell
Centre for Forensic Linguistics
School of Languages and Social Sciences
Aston University

A thesis submitted for the Degree of Doctor of Philosophy
March 2012

©Isabel Carlota Picornell, 2012
Isabel Carlota Picornell asserts her moral right to be identified as the author of this thesis.

This copy of the thesis has been supplied on condition that anyone who consults it is understood to recognise that its copyright rests with its author and that no quotation from the thesis and no information derived from it may be published without proper acknowledgement.

Aston University

Cues to Deception in a Textual Narrative Context:

Lying in Written Witness Statements

Isabel Carlota Picornell

Doctor of Philosophy

2012

Thesis Summary

Little research has been undertaken into high stakes deception, and even less into high stakes deception in written text. This study addresses that gap. In this thesis, I present a new approach to detecting deception in written narratives based on the definition of deception as a progression and focusing on identifying deceptive linguistic strategy rather than individual cues. I propose a new approach for subdividing whole narratives into their constituent episodes, each of which is linguistically profiled and their progression mapped to identify authors' deceptive strategies based on cue interaction. I conduct a double blind study using qualitative and quantitative analysis in which linguistic strategy (cue interaction and progression) and overall cue presence are used to predict deception in witness statements. This results in linguistic strategy analysis correctly predicting 85% of deceptive statements (92% overall) compared to 54% (64% overall) with cues identified on a whole statement basis. These results suggest that deception cues are not static, and that the value of individual cues as deception predictors is linked to their interaction with other cues. Results also indicate that in certain cue combinations, individual self-references (I, Me and My), previously believed to be indicators of truthfulness, are effective predictors of deceptive linguistic strategy at work.

Keywords: Linguistic cues, Deception strategy, Episodes, Cue progression, Temporal lacunae

ACKNOWLEDGEMENTS

It is my pleasure to thank those people who made this thesis possible.

First and foremost, I am deeply indebted to Gary Prideaux, Professor Emeritus of Linguistics at University of Alberta. He very kindly shared his work on narrative episode constructions with me, from which the idea for this research came. He gave me the confidence to embark on this PhD and has remained a staunch supporter throughout.

I gratefully acknowledge the supervision of Professor Malcolm Coulthard and Dr Tim Grant from the Centre for Forensic Linguistics at Aston University. I am particularly grateful to Professor Coulthard for taking me on as a PhD student in the first place, and to Dr Grant for seeing me through to the end. They provided structure and direction to my research without which I would have lost my way.

My sincere thanks goes to Sergeant Larry Barksdale of the Lincoln Nebraska Police Department. Without his support, this study would have not have been possible.

Being a distance part-time research student is a lonely affair and it was difficult staying motivated. So I am indebted to colleagues from the Centre for Forensic Linguistics and IAFL conferences who made these six years very special and encouraged me along this journey; I am honoured to count them as friends. I would also like to thank Wendy Simpson and Rod Paris for reviewing my thesis and ensuring that what I wrote made sense in English.

To my parents, Pedro and Angelita Picornell, I owe the fact that I have come this far. They believed in the importance of education, and my three brothers and I left university with Masters Degrees. But my Father always wanted a PhD in the family -- and so, it is to him that I dedicate this thesis.

Last but certainly not least, I am eternally grateful to David Earl. Without his support and understanding, cajoling, threats and encouragement, this thesis would never have been completed.

Contents

CHAPTER 4

CHAPTER 5

Table of Figures

List of Appendices

CHAPTER 1

1. Deception: Definition and Literature Review

1.1. *The Evolution of Deception*

For as long as there has been life on earth, there has been deception. The evolution of life is linked intrinsically with natural selection, which is in turn linked with the development of communication, which is inseparable from deception. By successfully manipulating the behaviour of others, ostensibly by taking advantage of recipients' own rules, communicators gain an advantage, increasing their own fitness and, in the process, ensuring that they are therefore more likely to pass their genes on to the next generation (Wiley, 1983).

In some organisms, deception is unconsciously biological, like the mimicry of plants to attract pollinators or the camouflage of fish to escape predators. In others, it is cognitively conscious, as in the behaviour of monkeys and of humans in order to mislead their colleagues to obtain a benefit for themselves.

1.1.1. Definitions of Deception

In its broadest sense, deception is defined as "The act of deceiving or the fact or condition of being deceived"[1]. In this socio-biological definition, conscious intentionality plays no part. No significance is placed on whether the deception is deliberate, whether it is a success or failure, or whether anyone (or anything) has benefited from the deception.

Mitchell's (1986) all-encompassing definition of deception uses a complicated formula:

(1) An organism R registers (or believes) something Y from some organism S, where S can be described as benefitting when (or desiring that)
(2a) R acts appropriately towards Y, because
(2b) Y means X; and
(2c) it is untrue that X is the case. [2]

Mitchell argues that while deceptions may not all have the same origins (and even if conscious intent is not present), the one thing they all have in common is that they are designed to deceive.

[1] Biology Online http://www.biology-online.org/dictionary/Deception [accessed 02 March 2010]
[2] Reproduced by permission from the State University of New York Press © 1985, State University of New York. All rights reserved.

Bond & Robinson (1988) adopt a slightly narrower definition to Mitchell, deception being "a false communication that tends to benefit the communicator"[3], where deceivers promote a fictional truth that obtains for themselves some advantage. Although conscious intent is still absent from this definition, it nevertheless indicates that there has to be a purpose for the false communication, which is to benefit the deceiver.

Güzeldere, Nahmias & Deaner (2002) structure deception definitions by proposing a categorical organisation - *genetic*, *learned*, and *intentional* - based on how deceivers understand their deceptive actions.

At the lowest level, deception is genetically programmed and deceivers have no responsibility for their own behaviour. In his book *On the Origin of Species*, Darwin (1859) argues that under changing conditions of life, organic beings who adapt more readily to those conditions are more likely to survive. These organisms in turn produce offspring with similar characteristics, improving their own chances of survival in their environment. Darwin refers to this suitability of organisms to their environment -- the "principle of preservation, or the survival of the fittest" -- as Natural Selection.

Darwin (1862) also suggests that natural selection can be seen in co-evolution between plants and their interactors (with specific reference to orchids and how they lure their pollinators) whose modifications and adaptations involve a considerable element of floral-deception which allow plants to adapt positively to their environment. In the plants' case, their evolutionary strategy of mimicry and camouflage is programmed into their genetic make-up through a period of natural selection.

Such organisms do not intend to deceive or choose to misrepresent themselves to their pollinators, prey or enemies. However, while conscious intent may be absent, the deception is appropriate and adapted to their circumstances. Deceptive adaptation is only successful because organisms respond appropriately to feedback from their targets, just like humans, albeit at a much slower pace.

In Güzeldere, Nahmias & Deaner's (2002) second deception category, deception is learned through a history of imitation and reinforcement. Animals may not intend to deceive but they are able to project the consequences of a course of action (learned in its normal context) onto another context in order to obtain a desired result. Lewin (1987) (as cited in Bond &

[3] Reproduced with permission from Springer and Science Business Media.

Robinson, 1988) reports such behaviour involving a young male baboon watching a female baboon dig for food on the ground. Glancing around him and seeing no other baboons in view, the young male screams as if attacked; his mother appears and chases the female away, leaving the young baboon free to eat the female's food.

It can be argued that while deceptive animals may understand how their actions achieve a specific objective (e.g. send baboon away and get her food), they do not have any conscious appreciation of why it works. However, there are those who believe that animals are capable of intentional deceit. Susan Blackmore argues that certain species of primates can "imagine events and manipulate them mentally...they have Machiavellian intelligence and the beginnings of a theory of mind"[4] (p. 75, Blackmore, 1999). This ability to put oneself in another's place, to understand how an individual may think and then manipulate the situation to misrepresent reality in such a way that is believable and acceptable to the individual being deceived defines Mitchell's third deception category – intentional deception.

In contrast to biologists and naturalists, cognitive scientists and psychologists require that deception be *intentional*, that deceivers need to have insight into the awareness of their intended victims. DePaulo, Lindsay, Malone, Muhlenbruck, Charlton & Cooper (2003) define deception as requiring intentionality, being "a deliberate attempt to mislead others"[5] (p. 77), while Masip, Garrido & Herrero (2004) require deception to include the intention to deceive, as well as deceivers' understanding that the information provided conveys a false picture.

"Deception can be understood as the deliberate attempt, whether successful or not, to conceal, fabricate and/or manipulate in any way factual and/or emotional information, by verbal and/or nonverbal means, in order to create or maintain in another or in others a belief that the communicator himself or herself considers false." (Masip, Garrido & Herrero, 2004, p. 148).

Güzeldere, Nahmias & Deaner (2002) argue that true deception is not only intentional but also requires a theory of mind, cognitive abilities which enable deceivers to understand the mental state of their victims, which non-human animals do not have. They further suggest that, while only humans are capable of intentional deception, their sophisticated cognitive behaviours are built up from the more basic learned behaviours found in other animal species.

[4] Reproduced with permission from Watson, Little Ltd (licensing agent).
[5] Reproduced with permission from the American Psychological Association

Smith (1987) disagrees. Genetically encoded behaviour and awareness of such behaviour are not mutually exclusive. Variation in deception behaviour patterns within and between animal species under the same environmental conditions suggests that animals make increasingly subtle adjustments in response to fine stimuli. Deception involves leading an individual into making an erroneous assessment of the environment, to the benefit of the deceiver.

1.1.2. Memes, Genes, Language and Deception

The suggestion that complex cognitive human deception evolved from lower-order animal-learned behaviour is expressed in the theory of *memes*. Dawkins (2006) takes Darwin's theory of natural selection from the biological into the cognitive by arguing that ideas, like genes, also undergo a natural selection process wherein the fittest ideas survive. Dawkins argues that living bundles of coded information capable of replicating themselves can be passed from one individual to another by imitation and mimicry. These ideas, or *memes*, lie dormant in an individual's memory until the person embarks on a selection process that triggers the resurgence of that meme. The most useful memes survive, subject to mutation and variation (as in biological natural selection) as they pass from one individual to another. In time, the least useful memes are abandoned and forgotten while the fittest memes co-evolve, eventually becoming the practices and beliefs that consolidate into a culture. This co-evolution of a vast complex of selectively learned ideas, Dawkins argues, also gave rise to language.

Blackmore (2008) expands on Dawkins' theory, suggesting that cognitive pressures on early hominids to select the best memes and imitate productive behaviour began to grow brain size and direct cognitive development, eventually resulting in the appearance of language. Blackmore sees language as an evolving organism shaped by increasing brain capacities that, in turn, influences the fitness of memes. Language and memes in early hominids (like plants and their pollinators) co-evolve to take maximum advantage of each other, the changes in one driving changes in the other, and both of them driving an increase in brain size.

Blackmore (1999) hypothesises that the same cognitive pressures that allowed early hominids to learn by imitation (best hunting or tool-making techniques etc) also applies to deception. Deceiving someone, just like imitation, requires that deceivers put themselves in other people's mindset and imagine how they will respond, in order that those being lied to (or imitated) will find the deception/imitation credible. In addition, Güzeldere, Nahmias &

Deaner (2002) argue that deception and the development of language are interrelated. They suggest that the evolution of human verbal communication was crucial to the development of deception as it is extremely difficult to identify intentional deception that does not involve telling lies.

In effect, deception is truth mimicry and humans have evolved to be expert at it, not only memetically (through the passing on of ideas), but also genetically.

Studies into familial traits by Martin & Eyesenck (1976), Young, Eaves & Eyesenck (1980) and Martin & Jardin (1986) report that family members share a tendency to lie that cannot be explained by purely environmental factors, and that such similarities can only be the result of shared genes. Genes from good deceiver-parents provide their offspring with the ability to be good deceivers too, while memes learned from observing effective deception strategies from parents and other role models develop and refine offspring's deceptive skills.

Human psychological mechanisms appear to have evolved to aid and abet deception. The foundations of conversation, as described by Grice (1975) in his Cooperative Principles and conversational Maxims, are built on the theory that speakers are assumed by their communication partners to be truthful, clear, relevant and unambiguous. They take for granted that speakers are being cooperative and take information given by them at face value. Speakers violating the maxims are liable to mislead; in particular, violations of the Maxim of Quality are perceived by addressees to be significantly more deceptive than truthful messages (McCornack, 1992). Galasinski (2000) describes deception as a common parasitic feature of human communication. Like leeches, deceivers piggyback on speech acts that originally evolved to facilitate communication and take advantage of the Cooperative Principle. While deceivers may pretend to cooperate, they are in fact being deliberately uncooperative in intending to mislead.

In the same way that natural selection breeds expert deceivers, so too it breeds expert deception detectors. Being a good deceiver conveys an evolutionary advantage to an individual, but so does being a good deception detector (Dawkins & Krebs, 1978). Dawkins & Krebs (1979) liken co-evolution to an arms race wherein evolutionary adaptations on one side produce counter adaptations on the other and so on and so forth, escalating constantly. While the apparatus or strategy might get better, it does not necessarily become more effective as the other side is also improving at the same time.

However, Bond, Kahler & Paolicelli (1985) argue that deception skills have evolved further than deception detection skills. Human individual differences in the ability to deceive are larger and vary more in their deceptive strategies than the ability to detect it. In fact, practically everyone has only the smallest ability to detect lies (Bond & DePaulo, 2008). Evolution, so says DePaulo, Lindsay, Malone, Muhlenbruck, Charlton & Cooper (2003), favours the flexible liar

1.2. *The Flexible Liar: Approaches to Deception and Deception Detection*

1.2.1. Accurately Identifying Deception

Studies through the years have generally shown that people's deception detection accuracy rarely exceeds little more than chance (Zuckerman, DePaulo & Rosenthal, 1981; DePaulo, Stone & Lassiter, 1985; DePaulo & Pfeifer, 1986; Ekman & O'Sullivan, 1991). In his review of 39 studies on spoken deception published after 1980, Vrij (2000) reports that, overall, receivers of deceptive messages only have 57% accuracy in identifying deception. Subsequent reviews (Vrij & Mann, 2005; Granhag & Vrij, 2005) of lie detection studies involving practitioners (police etc) report even lower accuracy rates of 55%. Levine et al. (1999) believe the rate is even lower. They argue that there are large differences between people's ability to correctly judge truth and identify deception and that, in fact, people are more likely to identify truths correctly and lies incorrectly. Buller, Strzyzewski & Hunsaker (1991), for example, report exceptionally low results with 29% accuracy in identifying deception and 81% for identifying truths, although Vrij, Mann, Robbins & Robinson (2006) obtain exceptionally high results with 72% lie accuracy and 70% truth accuracy (averaged over four tests). However, Vrij et al. stress that their detectors' performances lacked consistency and suggest that, as this study dealt with real life high-stakes deception (in contrast to the earlier laboratory designed student studies), the lies may have been easier to detect.

The most common excuse for poor deception detection rates is that people tend to focus on stereotypical behaviours when trying to identify deception, relying on generally held, albeit diagnostically poor preconceptions as to how deceivers should behave (Miller & Stiff, 1993). Hubbell, Mitchell & Gee (2001) sum up the consensus saying, "It is considered axiomatic in the deception literature that individuals are at best inaccurate at deception detection... Overall, the probability of accurately detecting deception is slightly greater than chance"[6] (Hubbell, Mitchell & Gee, 2001, p.1).

[6] Reproduced with permission from Taylor & Francis.

However, DePaulo, Rosenthal, Green & Rosenkrantz (1982a) argue that these statistics do not correctly reflect people's ability to identify deception. On the contrary, people are generally very good at detecting differences between truthful and deceptive messages but, in the absence of other supporting evidence, they are reluctant to make the inferential leap that the person is lying. Reviewing omitted evidence from previous studies, DePaulo et al. suggest that meta-analysis rating the veracity of truths against the rated veracity of lies on a multipoint rating scale (as opposed to percentage correctly identified) shows that people do in fact have a strong discriminative ability and regard lies as less credible than truths 85% of the time (Bond & DePaulo, 2006). It appears that the difficulty is people are unable to translate this discrimination into positive identification of deception.

Such conclusions are problematic due to two reasons. Firstly, deception has different characterisations. Lying takes a multitude of forms. DePaulo, Kashy, Kirkendol, Myer & Epstein (1996) categorise lying into three groups: *outright* (total falsehoods), *exaggerated* (overstated facts or impressions), and *subtle* (evasions, omissions, and literal truths) lies. The vast majority of these lies are unremarkable, told in a social context and are of little consequence to deceivers. They do not experience much regret in telling them, nor do they expect to get caught; and even when they are caught lying, the consequences are little more than temporary slight embarrassment. This type of lying is an integral part of everyday life (DePaulo et al. 1996; DePaulo & Kashy, 1998; DePaulo et al. 2003). Overall, cues for these lies are very weak and are unlikely to be identified (DePaulo et al. 2003).

However, interspersed amongst this social lying are serious lies; should deceivers be caught, the consequences to them would be costly. Deceivers are highly motivated to succeed with this deception, so much so they may be burdened by guilt at their transgression, by concern as to how well their deception is being received, and by fear of failure and the implications to their reputation and well-being should their deception be detected. In such circumstances, deception cues are likely to be stronger (DePaulo et al. 2003).

Such motivation to lie would be difficult to recreate ethically in a laboratory environment and therefore difficult to test, leading to the second problem: experiments are conducted under different contexts and limitations. In laboratory and controlled experiments, raters are forewarned to expect deception and told to differentiate between lies and truths; this does not happen in real world scenarios. Much research relies on speech content and behaviour analysis of experimentally constrained deception where deceptive features and the way they are defined differ from study to study, as well as the manner in which the cues are extracted.

The structure of experiments varies considerably, with people much more able to differentiate between truth and deception in certain communication media (such as reading a transcript) than others (when watching a video) (Vrij, 2005). Lies in laboratory contexts are largely trivial in nature and participants are required to lie convincingly in the absence of real-life motivation, irrespective of their actual ability to deceive. In addition, people are vulnerable to judgemental biases and preconceptions regarding what constitute truthful and deceptive behavioural cues, and this hampers their ability to identify real deceptive behaviour.

Zuckerman, DePaulo & Rosenthal (1981) report a *Truthfulness Bias* effect (termed *truth-bias* by McCornack & Parks, 1986) wherein people have a general tendency to ascribe truthfulness rather than deception to messages in experiments, irrespective of the messages' veracity. People do not expect deception until they actually detect it (Zhou & Zhang, 2007); this leads them to judge messages as truthful even when it is false and there are obvious signs of deception (Levine, Parks & McCormack, 1999). While people are generally poor at identifying deceptive messages, Vrij (2000) reports that they are able to identify truthful messages 67% of the time, while Buller, Strzyzewski & Hunsaker (1991) observe an even higher accuracy rate of 81% in their study.

On the other hand, preconceptions regarding what constitutes deceptive behaviour create a slight lie bias, which also results in incorrect judgements. Toris & DePaulo (1985) report when people are forewarned to expect deception, they identify it more often than those who have not been forewarned. However, when deception is anticipated, expectations of dishonesty lead people to focus on the wrong sort of behaviour, missing the correct cues.

Stereotypical beliefs as to what constitutes deceptive behaviour result in unusual behaviour being judged as deceptive even when the individual is being truthful. In spite of this, Hubbell, Mitchell & Gee (2001) argue this lie-bias effect is not strong enough to overturn the truth-bias effect, although Vrij & Mann (2005) found that, while this may be the case for laypersons, it does not apply to professional lie catchers such as the police. In fact, Meissner & Kassin (2002) identify a tendency for longer-serving police officers to judge suspects as deceptive compared to their shorter-serving colleagues. While Vrij, Mann, Kristen & Fisher (2007) did not find this correlation in their study, they suggest that the style of police interviewing affects the strength of the lie bias, with police engaged in accusatory interviews (as opposed to police engaged in information-gathering interviews) more likely to incorrectly continue to believe a suspect to be guilty.

1.2.2. Leakage of Deception Cues

Although some argue that deceivers and deceiver-detectors have reached equilibrium in the deception evolutionary arms race (Dawkins and Krebs, 1979), and others do not (Bond, Kahler & Paolicelli, 1985), the idea that human deception can be identified through behaviour and language continues to capture researchers' imagination. Approaches to deception detection work on two premises: that people behave, speak and write differently when they are lying than when they are telling the truth; and that in spite of deceivers' efforts to appear truthful, behaviours triggered by emotions (such as guilt and fear) and cognitive pressures associated with lying can be identified.

Freud observed that how people subconsciously feel about someone or something is reflected in how they behave, "He that has eyes to see and ears to hear may convince himself that no mortal can keep a secret. If his lips are silent, he chatters with his fingertips; betrayal oozes out of him at every pore" (Freud, 1905, p. 94).

Ekman & Friesen (1969) were the first to suggest that cues to deception might be observed in physical behavioural *leakages* which deceivers are unaware of and therefore do not control as well as their more overt behaviours. Studies on self-control have since found that individuals are generally unable to manage all their behaviour even when they are aware of them. Muraven & Baumeister (2000) argue that even if deceivers do try to control all of their behaviour, individuals only have finite self-control over their cognitive resources and, hence, deceivers would be unable to do so. Deliberately trying to control some behaviour uses up such considerable cognitive control resources that people are normally unable to control all of their other behaviour at the same time. Baumeister, Bratslavsky, Muraven & Tice (1998) further argue that managing current behaviour uses up so much cognitive resources that it reduces one's ability to control behaviour as effectively in the future.

Since deceivers attempting to manage their behaviour are unable to monitor and control all of it, they instead focus on controlling what they believe to be their most important behaviour and ignore others, which leaves such channels open to leakage. Documented by DePaulo & Kirkendol (1989) and termed *The Motivational Impairment* effect, serious attempts to control physical behaviour (including what deceivers themselves deem to be stereotypically deceptive) result in increasingly unnatural behaviour. Consequently, deceivers who are highly motivated to succeed in a deception (and are visible or can be heard by their addressees) are less successful than those who are less motivated as they are more likely to be detected, particularly when deceivers attempt to control all of their behaviour at the same time (DePaulo, Kirkendol, Tang & O'Brien, 1988). Eventually, deceivers would be unable to control even limited behaviour successfully as they use up their cognitive management resources (in agreement with Baumeister et al. 1998). This is consistent with Butterworth (1978, as cited in DePaulo et al. 2003) who argues that such depletion of resources might result in deceivers being unable to monitor adequately their addressees' reactions to the deception and consequently fail to adjust their deception strategy successfully in response to that feedback.

The difficulty is that while attempted control and fear leakage may indicate that individuals are experiencing strong emotions, it does not necessarily mean they are lying. Such leakage does not reveal the reason for the emotion, which could just as easily indicate fear of not being believed as being caught out in a serious lie, and the serious consequences for either. Furthermore, Mann, Vrij & Bull's (2002) study involving real life high-stakes deception reveals that there are huge individual differences in deceivers' behavioural leakages, including those that go against behaviour traditionally associated with deception.

Freud (1901) also extended the impact of the subconscious to speech, believing that the word choices people make betray unconscious emotions and motives which are reflected in their verbal communication through *parapraxes* -- speech errors and word slips. He cites as an example a doctor saying to his patient "If, as I hope, you will not leave your bed soon…", reflecting a conflict between the doctor's subconscious wish (to keep treating the well-to-do patient for longer so as to be able to continue charging his fees) and his overt desire (to see her get better). Freud further observes that word slips are made more readily in writing than in speech, possibly because the delay in writing down an idea held in the author's mind allows other thoughts and emotions to interfere in the process, therefore finding their way on to the page too.

> "In the course of normal speaking the inhibitory function of the will is continuously directed to bringing the course of ideas and the articulatory movement into harmony with each other. If the expressive movement which follows the idea is retarded through mechanical causes, as is the case in writing…such anticipations make their appearance with particular ease" (Wundt, 1900, as cited in Freud, 1901, p. 131).

The theory, that conflict between someone's privately and publicly held beliefs manifests itself in speech errors, is supported by Mehrabian (1971) and Zuckerman, DePaulo & Rosenthal (1981). Weiner & Mehrabian (1968) further propose in their concept of *immediacy* that word choice reflects individual thought. They argue that the psychological relationship between speakers and the subjects of their communication can be determined by scrutinising referents used by the speakers, and that these can be interpreted independent of context. Verbal distancing (*non-immediacy*) between speakers and their communication allows them to stand back subtly from fully validating the information they provide when they lie. Wagner & Pease (1976) expand on this, hypothesising that non-immediacy arises from the conflicts that speakers experience when their expressed beliefs are inconsistent with their privately held opinions.

Other studies support the relationship between verbal non-immediacy and inconsistencies in speakers' expressed beliefs and their unexpressed opinions. Kuiken (1981) reports that increases in non-immediacy are associated with fabricated statements, although he is unsure whether this results from speakers' uncertainties over their fabrications or because of the inconsistencies themselves. DePaulo et al. (1996) suggest that deceivers verbally distance themselves from their expressions because they might feel distressed at telling lies; even if they feel no such distress, deceivers lack the emotional investment and personal involvement in the claims they make as they are distanced naturally from the information.

However, Buller & Burgoon (1996) argue that deception is not so straightforward and deceptive strategies (and therefore linguistic cues) are heavily dependent on the context in which they are produced. In their *Interpersonal Deception Theory* (IDT), Buller & Burgoon (1996) present a framework for how deception works from a conversation perspective. Deception is adaptive, they argue; there is no such thing as a single profile for deception because deceivers vary their linguistic behaviour according to their intentions and the circumstances of the deception (Burgoon, Buller, Floyd & Grandpre, 1996a). Factors such as the seriousness of the lie and the consequences of its discovery for deceivers' reputation and well-being, their motivation to deceive, their relationship with their addressees, and addressees' degree of suspicion towards the deceptive information all influence deceivers' choice of deception strategy.

Unlike truth tellers, deceivers do not take their credibility for granted (DePaulo et al. 2003; Kassin & Gudjonsson, 2004) and they are prepared to adapt their deceptive strategy to suit the situation. Deceivers are more likely to monitor their addressees' reactions in order to check whether they are getting away with their lies (Schweitzer, Brodt & Croson, 2002) and adjust their behaviour to their ongoing interaction with addressees in order to make their messages appear truthful (Burgoon, Stern & Dillman, 1995). Pennebaker, Mehl & Niederhoffer (2003) sum it up saying, "What we say and how we say it changes depending on the situation we are in" (p. 562).

Buller & Burgoon (1996) suggest that, while monitoring the reactions of their addressees might be cognitively difficult at first, deceivers do gain confidence and increase their cognitive control as their deceptions progress. Thus, they are able to adjust their strategies successfully as their deceptions develop, resulting in increased communication confidence and more immediacy instead of distancing, contrary to Butterworth (1978) who argues that depletion of cognitive resources may interfere with deceivers' ability to monitor their addressees' reactions effectively.

DePaulo et al. (2003) also agree that the requirement for increased regulatory control during deception does not always result in the depletion of cognitive resources. They challenge earlier approaches to deception detection by arguing that the premise, that it is more cognitively difficult to lie than to tell the truth (hence, the deception cues), is not always the case. Suggested cues to deception are not constant, nor do they always identify deception. Simple lies of everyday deception do not raise arousal levels above that of telling the truth and deceivers do not worry about being caught lying (DePaulo et al. 1996; Vrij, 2000).

Telling the truth can be just as equally demanding cognitively, if not more so than routine social or simple rehearsed lies, particularly if this involves the careful presentational editing of difficult-to-tell or threatening truths. Humans are such competent deceivers that most lies leave only weak cues in verbal behaviour, otherwise deception detectors would have recognised them a long time ago. However, when deception becomes more cognitively demanding than truth telling, deception cues become more apparent (Zuckerman et al. 1981; DePaulo et al. 2003).

Personality also plays its part in language and, therefore, deception. People have a wide range of linguistic variation between them (Biber, 1988) and psychological evidence suggests that personalities such as Neuroticism and Extraversion influence significantly the way people speak and write (Pennebaker & King, 1999; Gill & Oberlander, 2002; Campbell & Pennebaker, 2003; Gill & Oberlander, 2003; Pennebaker, Mehl & Niederhoffer, 2003; Oberlander & Gill, 2004; Mehl, Gosling & Pennebaker, 2006). Pennebaker & King (1999) suggest that high immediacy (such as use of First Person Singular Pronouns) is characteristic of Neurotic personalities, while Oberlander & Gill (2004) find that Neurotics use more pronouns generally, and also repeat themselves frequently, leading to very low speech lexical density (Gill & Oberlander, 2003). Extroverts prefer to use *other* references while Introverts prefer self-references (Gill & Oberlander, 2002).

Indeed, the complexity of language, the different characterisations of deception and the variability in verbal deception strategies is such that, to date, no single linguistic cue or set of cues has been found to occur only during deception and not at any other time (Zuckerman, DePaulo & Rosenthal, 1981; DePaulo et al. 2003). Overall, results are erratic and no cues consistently emerge as valid across topic, time, context, and medium. Deceivers do not always lie in the same way.

1.3. *Linguistic Cues to Deception: Previous Research*

Research on deception across the board has been based largely on theoretical assumptions regarding how deception affects people's thoughts, feelings and cognitive processes, and how this might be reflected in language when people lie compared to when they are telling the truth. Undeutsch (Undeutsch, 1967, as cited in Vrij, 2005) hypothesises that the quality and content of fabricated statements will be different to that of truthful statement because inventing a false memory requires more cognitive creativity and control than remembering an actually experienced event. Termed the *Undeutsch hypothesis* (Steller, 1989, as cited in Vrij, 2008), this led to the development of certain criteria that is used to check the credibility of statements in verbal assessment tools (Vrij, 2008) such as Statement Validity Analysis.

Although results in this field have been contradictory, four linguistic features have been the subject of focus by deception researchers: word quantity, pronoun use, emotion words and markers of cognitive complexity.

1.3.1. Word Quantity

The literature on word quantity is contradictory. Some research has found that deceivers provide shorter verbal responses compared to truth tellers when lying (Vrij, 2008; DePaulo et al. 2003; Hartwig, Granhag, Stromwall & Kronvist, 2006). Deceivers are said to have moral qualms about their deception and therefore fail to embrace their lies as fully as they do their truth telling (Weiner & Mehrabian, 1868). This possibly results in deceivers not wanting to provide too much information regarding a scenario for which they have no actual experience (Vrij, 2008) as saying too much makes it easier for them to be caught out lying, particularly if they are to be re-interviewed by police and end up contradicting themselves (Granhag & Stromwall, 1999). Deceivers may also find managing misinformation to be too cognitively demanding (DePaulo et al. 2003) or believe that their nervousness is overtly visible in their speech behaviour (Savitsky & Gilovich, 2003). Consequently, it is easier to say as little as possible.

Truth tellers, on the other hand, say more. They see the truth as being obvious to others and have no need to watch what they say. Belief in their own truthfulness and the transparency of that truth encourages truth tellers to be more forthcoming with information, resulting in longer statements than those provided by deceivers (Hartwig et al. 2006). Deceivers also think that their deceptive behaviour is obvious to others (Gilovich, Medvec & Savitsky, 1998) and so they need to work harder at being careful with information, which results in saying less. Gilovich, Medvec & Savitsky (1998) refer to this "tendency for people to overestimate the extent to which others can read one's internal states" (p. 332) as the *illusion of transparency*. This perception, that a *social spotlight* shines brightly on what one is thinking or how one behaves, arises out of people's inability to see beyond their own experience of themselves.

However, other studies also find that deceivers use more words than truth tellers (Anolli & Ciceri, 1997; Anolli, Balconi & Ciceri, 2002; Burgoon et al. 1996a; Burgoon et al. 2003; Zhou, Burgoon, Zhang & Nunamaker, 2004a; Hancock, Curry, Goorha & Woodworth, 2004; Hancock, Curry, Goorha & Woodworth, 2005; Zhou & Zhang, 2007). Believing their deception to be more transparent than it actually is, deceivers feel the need to provide a complete story filled with the sort of detail they assume is typical of truthful recall (Burgoon et al. 1996a) or they try to hide their lies within a mass of truthful, albeit irrelevant, information (Anolli, Balconi & Ciceri, 2002). However, Vrij, Mann, Kristen & Fisher (2007) find no difference in statement lengths between truth tellers and deceivers when lying orally.

1.3.2. Pronoun Use

Weiner & Mehrabian (1968) suggest that the degree to which speakers associate with (*immediacy*) or distance (*non-immediacy*) themselves from their addressees or the subject of their communication can be identified through the literal interpretation of the referents they use, rather than through connotative meaning. An example would be differences in the literal meaning of *We* and *You and I*, where a speaker associates her/himself together with the addressee in the former, but disassociates her/himself in the latter.

Deceivers' lack of embracement and their desire to disassociate themselves from their lies lead them to refer to themselves in their communication less often (Weiner & Mehrabian, 1968). Using First Person Singular Pronouns involves taking ownership of the information provided, which deceivers are less likely to do, resulting in a significant *third person* orientation (Newman, Pennebaker, Berry & Richards, 2003). The association between Third

Person Pronouns and deception finds strong theoretical support from DePaulo et al. (2003) who argue that deceivers may find First Person Singular Pronouns uncomfortable to use as this would require associating themselves too closely with false information for which they have no experience of, or emotional investment in.

Deceivers' attempts to move focus away from themselves to third parties result in communication with fewer First Person Singular Pronouns (e.g. *I*, *Me*, and *My*) and more Third Person Pronouns than truth tellers (Weiner & Mehrabian, 1968; Knapp, Hart & Dennis, 1974; Knapp & Comadena, 1979; Vrij, 2000; Burgoon, Blair, Qin & Nunamaker, 2003; Zhou, Burgoon, Nunamaker & Twitchell, 2004b; Hancock et al. 2004; Hancock et al. 2005).

However, some studies contradict this. Newman et al. (2003) report that while deceivers consistently use fewer First Person Singular Pronouns than truth-tellers in their written deception, they also use fewer Third Person Pronouns. They suggest this may be due to the topic (abortion attitudes) being written about in their experiment; deceivers may prefer to enhance the credibility of their deception by referring to specific people instead of simply using the pronoun *She*. Bond & Lee (2005) find similarly in their study involving oral deception, suggesting that in their case (prison inmates' truthful and deceptive conversations), this might be due to the type of stimuli used, with prisoners commenting on people depicted in a video, which would require the use of such pronouns. Zhou, Burgoon, Twitchell, Qin & Nunamaker (2004c) also find in their study on written computer messaging that Third Person Pronouns are higher in truthful than deceptive messages.

These conflicting findings are reflected in Vrij's two major reviews of deception studies. Vrij reports in his first (2000) review that deceivers use more *other* references than truth tellers. However, in his second (2008) review, Vrij states that, in fact, there does not appear to be any relationship between self-references, immediacy and deception, and most of the findings reporting the association only comes from the Burgoon et al. group of researchers; the majority of other research found either no association or only weak ones.

1.3.3. Emotion Words

Guilt and negative emotion experienced by deceivers during deception may also leak into their language (Newman et al. 2003; Vrij, 2008), resulting in more negative statements (Knapp & Comadena, 1979; DePaulo et al. 2003; Zhou et al. 2004c) and more negative emotion words (e.g. *hate, worthless, enemy* etc) (Newman et al. 2003) than truth tellers.

However, the literature on this is also contradictory. DePaulo et al. (2003) report only a weak association between negative comments and deception, while Hancock et al. (2004 & 2005) identifies no support for the association. Although their study involves physical rather than verbal behaviour, Mann, Vrij & Bull (2002) argue that their findings suggest nervousness might not have such an impact on behaviour as generally believed. In their real life high stake deception study, suspects blink less when lying, indicating behaviour affected by cognitive loading; in prior research, nervousness resulted in increased blinking.

However, negation as an indicator of obfuscation and not of emotion may have a part to play in deception studies. Only a handful of researchers to date have considered the use of negation (e.g. *no*, *not*, *never*) as a deceptive cue, as opposed to their inclusion in a class of negative (emotion) words. Hancock et al. (2005) report in their study into deceptive email and instant messaging that unmotivated senders increase their use of negation during deceptive interactions, although motivated senders do not. Toma & Hancock (2010) also find that online daters who lie in their profiles use more negation than truth tellers, while Adams & Jarvis (2006) identify a marginal positive relationship between the use of negation and deception.

The easiest way to lie is to deny something. Hancock et al. (2005) argue that unmotivated deceivers prefer to create simple lies using simple negations, while motivated deceivers make more of an effort to construct elaborate deceptions. Deceivers may think that denying a statement alleging to be the truth is an easy way to lie, but simple lies do not necessarily result in plausible lies; simply denying that something *is* does not make the most convincing deception.

According to Wason (1965, as cited in Vasek, 1986), negation generally functions to emphasise a fact that is contrary to expectation. “Making a negative statement involves the idea of presupposition; that is something must be asserted in order to be negated”[7] (Vasek, 1986, p. 282). In other words, to be plausible, deceivers must first ground the negation in a suitable context that establishes a norm, and then negate it. This may be beyond the cognitive ability of many deceivers. Newman et al. (2003) report that using *exclusive* words (e.g. *except*, *without*, *but*) is a significant predictor of truthfulness and they argue that distinguishing between what belongs in a category (establishing the norm) and what does not (negating it) may be too cognitively complex for deceivers to juggle successfully.

[7] Reproduced with permission from Elsevier.

A less cognitively demanding form of deception involves the use of *equivocal negation* (e.g. *I'm not sure*, *I don't know* etc), a form of evasive negation that creates ambiguity without commitment to any actual information. Galasinski (2000) points out that, in saying what they did not know or did not do, deceivers offer no actual information as to their actions. Instead, saying what did not happen raises the question as to what actually did.

1.3.4. Cognitive Complexity

Deceivers' lack of actual experience in imagined events and the cognitive process involved in their manufacture also may be reflected in language.

According to Vrij, Mann, Fisher, Leal, Milne & Bull (2008), six aspects of deception contribute towards increased mental loading. Deceivers have to (1) deliberately formulate their lies, while (2) suppressing the truth, (3) monitor their behaviour while (4) monitoring their addressees' reactions, and (5) remember to stay in-role. Finally, (6) the lie itself may be cognitively difficult.

In addition to suppressing detrimental information, deceivers have to create an alternative story that is believable and consistent with the other facts. At the same time, they have to manage their communication in order to appear credible as well as ensure that their addressees respond favourably to the deception, or make strategic changes if they do not. All this requires mental juggling of information and cognitive resources that may prove to be beyond the ability of normal deceivers.

Various studies suggest that under certain condition, deception can be made even more cognitively burdensome (Vrij, Fisher, Mann & Leal, 2006), increasing the likelihood of discrimination between deception and truth telling. DePaulo et al. (2003) report that the cognitive burden of lying increases significantly when deceivers are required to provide longer responses during interview, as opposed to a simple *Yes* or *No* answer. Requiring a story be told in reverse order (Vrij, Mann, Fisher, Leal, Milne & Bull, 2008), or that a second task be carried out at the same time as telling the story (Vrij, Fisher, Mann & Leal, 2008) also greatly increases the cognitive burden of lying.

Sporer (1997) builds on the idea of cognitive burden by using the presence of *cognitive operations* as a criterion for lying in his set of rules by which oral and written statements may be judged truthful or deceptive, integrating Criteria Based Content Analysis (CBCA) and Reality Monitoring. CBCA forms part of the Statement Validity Analysis toolbox designed to assess the evidence of children involved in sexual-offences cases. It grades the truthfulness of transcribed interviews using 19 criteria based on the *Undeutsch Hypothesis* (Undeutsch, 1967), of which criteria 1-13 measure cognitive features. Vrij (2008) encourages the adoption of the Reality Monitoring cognitive operations feature into the CBCA checklist, arguing that otherwise there would be no lie criterion in CBCA assessment.

Reality Monitoring (RM) is defined as “the process by which perceived and imagined events are discriminated and confused in memory” (Johnson et al. 1988, p. 371). According to Johnson & Raye (1981), memories derived from actually experienced events, particularly in recent memory, result in vivid sensory-derived accounts containing more visual, spatial and contextual detail, e.g. *Around 12:20 a black male, 5’8” 170 lbs, wearing a black stocking cap, black shirt, long-sleeved or a light jacket, black baggy pants, tennis shoes, with a black automatic pistol came into the bank*.

On the other hand, internally generated (imagined) accounts produce fewer details and more subjective information based on cognitive processes and personal history, e.g. *He thought her crying always meant she needed something*.

Suengas & Johnson (1988) report that memories of imagined events lose their clarity and become vague after only 24 hours, degrading faster than experienced events. This reduction in detail and increased vagueness in internally generated memories is earlier identified by Knapp, Hart & Dennis (1974) who report that deceivers are less specific and more vague than truth tellers, use more *levelling* words suggesting “allness” (e.g. *every, all, none* etc), fewer absolute verbs, and more modal verb constructions (a feature also identified by Buller & Burgoon, 1994).

However, as with the other features, findings are contradictory. Studies into words identifying cognitive processes (e.g. *think*, *know*, *appear*) as a deception marker contradict each other, with some studies reporting increased cognitive information in deceptive accounts, while others identify more cognitive operations in truthful accounts (see review by Masip, Sporer, Garrido & Herrero, 2005). Vrij (2000) initially dismisses the use of cognitive words as a lie criterion, arguing that people use cognitive operations to encode their experiences into memory; he later reports that deceivers use more cognitive operations in their speech than truth tellers when recalling events in reverse order (Vrij, Mann, Fisher, Leal, Milne & Bull, 2008). Memon, Fraser, Colwell, Odinot & Mastroberardino (2010) report that cognitive operation words occur more often in truthful than deceptive accounts (although not statistically significantly when controlled for response length) in their own study using RM.

Inconsistency in definition as to what constitutes cognitive operations may be partly responsible for these discrepancies (Sporer, 2004; Memon et al. 2010). For example, Johnson & Raye (1981) describe cognitive operations as thoughts going on in someone's mind reflecting idiosyncratic memory e.g. *When I was very sure [about my words] I could remember I had a very specific reason for making the association*. However, Vrij (2008) broadens the definition to include inferences about sensory observations e.g., *I must have had my coat on as it was very cold that night*.

Colwell, Hiscock-Anismas, Memon, Rachel & Colwell (2007) suggest that differences in stimuli used during experiments might also be responsible for these conflicting findings. In one experiment, students watch a videotape of a simulated theft and are asked to provide truthful and deceptive statements regarding the event. In the first experiment, truthful statements contain more cognitive references than deceptive statements. However, in the second experiment, where prison inmates witness a staged theft with live actors, deceptive statements relating to the event contain significantly more cognitive references than truthful ones. Consequently, Colwell et al. suggest that perhaps simply viewing videotapes does not reproduce the vivid stimuli found in real life situations necessary to generate deceptive cues.

1.4. *Deceptive Strategies*

Deception is influenced by the context in which it occurs (McCornack, 1987; Buller & Burgoon, 1996). Just like any other construction, deception is tailored with an eye on the environment in which it is created. Deceivers build their deception on truthful foundations over which they erect layers of ambiguity studded with falsehoods and omissions. As they progress with their deceptive construction, deceivers adapt to the changing landscape, altering and restructuring their communication blueprint as they encounter obstacles.

Part of the difficulty in identifying linguistic cues to deception lies in the diverse verbal strategies deceivers adopt in order to conceal their lies. The different strategies and the ability of deceivers to quickly regulate and amend their approach in response to the situation make standardised deception detection over a broad range of contexts difficult.

Research appears to suggest that deceivers adopt particular oral deceptive strategies according to their degree of preparation (Anolli, Balconi & Ciceri, 2002; Burgoon et al. 2003), and the attitude of their addressees (Anolli, Balconi & Ciceri, 2002). Some deceivers adopt a vague and verbose noncommittal personal approach when lying (Knapp et al, 1974; Kuiken, 1981; Buller & Burgoon, 1996), while others prefer to maintain a reticent attitude, using simpler concise impersonal constructions (Knapp & Comadena, 1979; Vrij, 1995); some are assertive in their deception while others appear uncertain (Anolli, Balconi & Ciceri, 2002).

When they have sufficient time to prepare their lie, or when lying to unsuspecting addressees, deceivers adopt a strategy of creating ambiguity through wide use of irrelevant information, vague and general references, and complex sentences using many words, modifiers and variation in voice. This involves embedding the lie in the middle of truthful sentences, thereby blurring the boundaries of the deception. This allows deceivers to be vague and non-committal, lulling unsuspecting recipients into comfortable acceptance of the deceptive message.

However, when addressees are suspicious and probing, or when deceivers have little time to prepare their deception, deceivers retreat and cut back on information, becoming reticent and saying as little as possible. This results in shorter concise sentences, with deceivers being more emphatic in their pronouncements, attempting to appear reliable by asserting the truthfulness of their information but, at the same time, avoiding further questioning. However, studies into the effects of probing on deception detection find that suspicious addressees end up attributing higher levels of truthfulness to deceivers rather than improving their deception identification (Buller, Comstock, Aune & Strzyzewski, 1989; Buller, Strzyzewski, & Comstock, 1991). Hartwig, Granhag, Stromwall & Vrij (2002) also report that probing did not increase accuracy rates of deception detection and suggest that perhaps probers did not appear suspicious enough to elicit a material change in behaviour from the deceivers, or deceivers misinterpreted the response cues they received.

Yet another strategy involves depersonalising the deception, whereby deceivers disassociate themselves from responsibility for, or connection with the lie. In this communication style, deceivers provide impersonal information, preferring to refer to third party experience instead of their own, increasingly relying on impersonal conditions (use of impersonal pronouns such as *One* or *We*) in order to reduce their personal liability by sharing responsibility for the information (Anolli, Balconi & Ciceri, 2002).

Thus, deceivers appear able to alter their communication strategy in response to their addressees' reactions, choosing the most effective approach to persuade or retreat as needed, enabling them to camouflage their deception within the interpersonal environment in which it occurs.

The response of deception detectors to this flexible deception approach has been to increase the cognitive load of lying in order to magnify differences between truth tellers and deceivers. Traditionally, researchers have only passively monitored the behaviour of the two groups during studies. With most deception cues being weak and difficult to identify in the first instance (Zuckerman et al. 1981; DePaulo et al. 2003), this has resulted in poor detection rates (Vrij, 2008). However, by creating situations that aggressively tax the cognitive resources of deceivers, differences between them and truth tellers are enhanced and deception cues become more easily identifiable.

This approach has been used in structuring police interviews, with positive results. Vrij et al. (2008) require interviewees to narrate events in reverse order, resulting in considerably more obvious behavioural differences between deceivers and truth tellers, including deceivers' use of more cognitive operations (thought and reasoning and cognitive supposition of sensory experiences). Hartwig, Granhag, Stromwall & Vrij (2005) use late disclosure of evidence in interviews (as opposed to disclosure in the early part of the interview) to make interviewees feel more nervous. This results in deceivers providing shorter statements with less detail than truth tellers as well as an increase in cognitive operations, where deceivers end up contradicting themselves more than truth tellers (Hartwig et al. 2006).

1.5. *Lying Cues: Verbal vs. Written Deception*

Undertake any course in identifying deception provided by security 'consultants' and the cues identified for verbal and written deception will be the same. Although there are psychological and linguistic reasons why deception cues will be different across media, there are simple reasons for not applying verbal cues to textual deception under current research information.

The first is that we use language differently when we speak and when we write, moving from language expressing reality as a process (spoken language) to reality as an object (written language). Where properties and processes are construed as verbs and adjectives in speech, the same processes and properties are construed as nouns in writing, the dynamic reality of language in motion being replaced by the synoptic representation of reality as an object (Halliday, 1993).

The second is that verbal cues as a deception signal are themselves not constant across verbal contexts, as the earlier contradictory findings and varied linguistic strategies reveal.

The third is that (the limited) existing studies in written deception indicate that cues are also not consistent across textual contexts.

The largest group of studies dealing with deception in written text is that by the information technology community, testing automated deception detection programmes in text based computer mediated communication (CMC) such as instant messaging and email. These studies provide insight into how people lie in written text.

1.5.1. Face-to-Face Communication and CMC Messaging

At first glance, CMC appears to be a halfway house between informal Face-to-Face (FtF) communication and written statements. In some ways, CMC retains aspects of speech. Although deceivers communicate in writing, the context remains a conversational one and the interaction between sender and receiver is time dependent as the sender expects a quick response.

Zhou et al. (2004a) suggest that basic deception cues found in FtF communication could be applied to interactive CMC messaging, describing it as *a kind of virtual conversation* where turn-taking is brief, context rich and immediate. Hancock et al.'s (2005) research into automated lie detection for email and SMS messaging points out that deceivers' linguistic style changes according to how message recipients view their communication, very similar to strategy adjustments made by FtF deceivers. However, what those cues are remain to be seen (Zhou et al. 2004b).

In CMC context, language cannot be used in a truly conversational manner. Extralingual aspects associated with conversation, such as speed or tone of speech, are not present and there is no opportunity to interrupt. Equally as important, the visual cues that aid with meaning are absent. A study by Woodworth, Hancock & Goorha (2005) into automated deception detection reveals that there are fundamental differences in detecting deception when people communicate FtF and when they lie in a CMC context. Woodworth et al. (2005) argue that, firstly, written text is largely the sole medium of communication in CMC. As communicators do not see each other, the physical behavioural cues available in FtF do not exist in the messaging and, consequently, the *Motivational Impairment* effect (the over-correction of nonverbal behaviour by highly motivated deceivers during deception) is excluded as a source of deception cues. Vrij, Edwards, Roberts & Bull (2000) believe that this elimination of nonverbal cues has the potential to block deception detection altogether in CMC exchanges, a view supported by Burgoon, Stoner, Bonito & Dunbar (2003) who report that deceivers appear more truthful than truth tellers in CMC exchanges.

Secondly, as Coulthard (1999) points out, the grammatical and lexical construction of verbal and written statements are considerably different.

> "As a generalisation spoken language tends to have short clauses, a low ratio of lexical to grammatical words and to present what happened as processes by verbs, whereas written language tends to have longer clauses, a higher lexical density and to present what happened as products by the use of nominalisations." (Coulthard, 1999, p. 111).

How emails fit in within this communication spectrum is more problematic than instant messaging. Email as a CMC medium cannot be treated as spoken language because, in addition to lacking the visual and intonational cues which convey nonverbal meaning, the longer response time (than instant messaging) normally associated with it removes the turn-taking context. Neither can it be treated as written language such as found in written monologue statements because it is produced more quickly and lacks the formal writing conventions normally associated with such texts.

Thirdly, important differences are also to be expected because time to construct the deception, pressure to respond to questions, and differences in response time all affect deception cues (Zhou, Twitchell, Qin, Burgoon & Nunamaker, 2003a; Hancock, Woodworth & Goorha, 2010). CMC deceivers have the advantage of being able to reflect on and edit their messages before transmission, compared to deceivers in FtF interactions. This lightens somewhat the cognitive burden of deception for motivated deceivers by allowing them a few more seconds or minutes respite, enabling them to be more selective in the presentation of their information. Furthermore, while FtF communication partners have the difficulty of needing to remember what was said previously in the conversation, CMC communicators have available to them a message stream recording the exchange, which can be reviewed at any time (Zhou & Zhang, 2007).

Studies also suggest that deceivers' word production differs between FtF and CMC. While the trend indicates that deceivers in an interactive FtF context use fewer words and provide fewer details and shorter responses when lying (Vrij, 2000; DePaulo et al, 2003; Burgoon et al, 2003), the opposite appears to be the case in CMC messaging.

In text-based CMC studies, Zhou et al. (2004b) find that deceivers use significantly more words during deception in their experiments with email communications, as did Hancock et al. (2004)(2005). This increased verbosity is also supported by Zhou & Zhang (2007) who report that, in a group decision-making task using instant messaging, deceivers tend to use a verbose persuasive strategy, dominating the argument by incorporating many facts and using rich language in order to manage the conversation flow and convince addressees of their truthfulness.

It also appears that deceptive language changes according to the opportunity for planning, rehearsal and editing, even within CMC media, producing different cues. Deceivers in synchronous communication (such as instant messaging) have less time to construct their written lies as an immediate response is normally expected, than those in asynchronous communication (such as email), where a reasonable response delay is expected. As a result, deceptive synchronous communication has briefer, less complex and less expressive communication, while those in asynchronous communication, with more time to plan and control their behaviour, produce texts which tend towards longer more elaborate messaging.

Burgoon et al. (2003) report that deceivers in a synchronous interactive context (interview conducted via text chat and FtF) produce shorter messages of greater complexity, in contrast to deceivers in an asynchronous email context covering several days, who produce longer messages with less complexity. However, a third study involving deception in a synchronous context (text chat, FtF and audio-conferencing) reports that deceivers' language tends towards briefer responses of low complexity than truth tellers'. Burgoon et al. attribute these differences in style to difference in media (text chat, audio chat, email) and the time available to prepare responses. Similar results are found with Zhou & Sung's (2008) study into synchronous CMC communication involving online chat with Chinese groups, with deceivers communicating less than truth tellers, while two studies by Zhou et al. (2003) (2004b) using asynchronous email exchange also reports deceivers using more words than truth tellers.

However, Hancock et al. (2004) (2005) (2008) find in their studies that deceivers produce more words during synchronous CMC messaging, contradicting the above trend. Hancock et al. (2005) suggest that the properties of the experiment may influence cue production in interactive CMC deception, which may explain the contradictory results. In the Burgoon et al. (2003) experiment, participants are asked to lie to an interrogator, while in the Hancock et al. experiments, participants are asked to lie in conversation. In the former, deceivers may be avoiding incriminating themselves by saying as little as possible while, in the latter, deceivers are trying to convince addressees of the truthfulness of their assertions. Context matters.

1.5.2. CMC Messaging and Written Witness Statements

As with FtF and CMC text interaction, studies so far suggest that the differences between CMC messaging and written statements are large. Even though CMC may be conducted largely in writing, there are material differences between it and the production of longer written statements, such as witness narratives, that are likely to affect linguistic cues to deception.

Written witness statements are textual monologues, without the turn-taking virtual conversation interaction that characterises CMC messaging. Although verbal monologues have been included in deception studies, these involve speaking to an observer according to instructions issued as part of the experiment. Thus, preparing a statement for later consumption by an addressee who is not present at the time of the writing of the statement presents a different communication context from speaking to a person who is present, even if that person does not respond. Buller & Burgoon's (1996) *Interpersonal Deception Theory* states that deceptive communication strategies differ between those engaged in interactive and non-interactive deception. Therefore, while observers are passive participants in the monologue, they are nevertheless still participants, as distinct from the recipients of statements (who will judge the veracity of the statement) who are not there at all.

Lacking the interpersonal relationship found in CMC communication, witness statement writers have no periodic feedback as to how well their deceptive strategy is working; this will come only once the statement has been written and unavailable for further editing. Having the time to prepare their story is of limited use to deceivers in the absence of feedback.

Consequently, lying witness statement writers have to decide at the outset which strategy might be the most successful in order to convince addressees of their sincerity, without the luxury of being able to build a relationship with them, or modify their deceptive approach.

Identifying an addressee is also problematic, as deceivers have no control over the distribution and readership of their statements, and it is unlikely they would be able to tailor them for all possible addressees.

This lack of control over the distribution of their witness statements and their inability to direct deception towards specific addressees could create a greater degree of arousal for deceptive writers than deceivers working in CMC contexts. Zhou & Zhang (2006) report that deceivers experience higher arousal levels when attempting to deceive larger groups of people, which increases the likelihood of leakage of deceptive cues and, in turn, the likelihood of probing questions from suspicious group members. In addition, producing texts such as narrative witness statements involve disclosing one's identity, in contrast with the anonymity normally associated with CMC communication where the source of information may be unknown and hiding behind a user-name. While anonymity helps to reduce participants' apprehension towards their group-colleagues (Valacich, Dennis & Nunamaker, 1992), there is no such comfort for the lying witness statement writer.

1.6. *Weaknesses in Deception Studies*

Some researchers have criticised weaknesses in deception studies, blaming such limitations on their own, as well as other studies, for the contradictory results they obtained.

Sporer (1997) admits that the incentives for participants to lie in his experiments are extremely weak. Both Bond & Lee (2005) and Colwell et al. (2007) suggest that the use of videotape in their studies may provide the wrong type of stimulus (resulting in truth tellers using more Third Person Pronouns than deceivers); Newman et al. (2003) wonder whether the topic (abortion attitudes) results in the same finding. Other researchers criticise the use of structured questions and settings which do not allow deceivers room to manoeuvre as in real life (Dulaney,1982), or the failure to examine whole discourses and participants' lack of freedom to choose their own deceptive strategies (Dilmon, 2009). Participants in research experiments are given permission to lie, which is likely to eliminate any guilt feelings they may have about deceiving someone else (Mann, Vrij & Bull, 2002).

Porter & Yuille (1996) criticise the lack of diversified research populations. Most deception studies use students and research suggests that students do not behave deceptively in the same way as those regularly found in deceptive environments (Porter & ten Brinke, 2010). Liars such as criminals who are more exposed to deceptive environments are more knowledgeable as to which deceptive strategies work and may produce more plausible deceptions and different cues. Kassin, Meissner and Norwick (2005) report that prison inmates they worked with lied with little difficulty and were adept at creating convincing false confessions.

A major limitation of deception studies is the inconsistency in the definition of deception (Sporer, 2004; Memon et al. 2010) and the focus on trivial lies, which make for poor deception models. This makes it difficult to assess the validity of the cues they report. Newman et al.'s (2003) approach to deception (linked to their studies on language and mental health) involve participants writing dishonestly on abortion attitudes. Hancock et al.'s (2008) participants lie about significant persons, unpleasant jobs and recent mistakes. Zhou et al. (2003) (2004) and Zhou & Zhang (2004)(2007) ask participants to rank items in terms of importance necessary for surviving in the desert after a plane crash and to falsely justify their decision to others. Zhou & Sung (2008) have participants playing an online game pretending to be mafia, villagers and police officers. Although Bond & Lee (2005) use prison inmates in their experiment, they still have them lying about trivia (a video they had watched). Such models cannot hope to replicate the strong emotions and cognitive pressures produced by high-stake deception, when the consequences of being caught out mean not getting paid $10, compared to being sent to prison and public humiliation.

A surprising revelation of the extensive literature review is just how inconsistently cues behave. Research papers tend to be selective about the previous studies they report on, giving the impression of consistency in findings when, in fact, this is not the case. Thus, deception research needs firmer foundations. It requires studies into real life high stakes deception to produce valid cues, which means research conducted outside of the laboratory environment as such conditions cannot hope to adequately replicate real world stimuli.

1.7. ***Narrative Analysis***

1.7.1. Linguistic Studies

Labov (1997) defines a narrative as "a report of a sequence of events that have entered into the biography of the speaker by a sequence of clauses that correspond to the original events" [8]. He differentiates between narratives of personal experience and narratives of simple observations, with the former reinterpreting actual events in the light of the narrators' emotional and social involvement, and the latter being a straightforward retelling of events.

[8] This definition is based on the original conception of Labov & Waletsky, 1967.

The work of Labov & Waletsky (1967) on narratives of personal experience is the bedrock upon which narrative analysis rests. Originating out of sociolinguistic field studies into how people speak when they were not being observed, Labov & Waletsky report that oral narratives share common structures, with fully formed narratives (those with a beginning, a middle, and an end) containing five[9] structural features: *Orientation* (setting the scene), *Complication* (what happened), *Evaluation* (opinion of narrator towards features in the narrative), *Resolution* (the outcome), and *Coda* (returning to the present time).

However, not all narratives contain all the structures. As a minimum, a narrative consists of two independent clauses containing the *Complication* separated by a temporal *juncture* (the time separating from each other the earlier and later actions reported in the clauses) where the interpretation of the order of events would change if the clauses were reversed (Labov & Waletsky, 1967). Thus, the chronological ordering of clauses and the semantic function of those clauses are important for providing meaning in narratives.

Bruner (1990) holds that this sequentiality is the key characteristic of narratives as “the sequence of its sentences, rather than the truth or falsity of any of those sentences is what determines its overall configuration or plot” (p. 43). The constituent features of narratives (the individuals involved, their mental states, and the events) derive meaning from their place in the overall plot configuration, and their interaction with other features at different levels in the narrative, according to the author’s perspective of reality (Barthes, 1996). Indeed, narratives are not objective retellings of what happened as narrators linguistically reconstruct reality to create meaning. They manipulate their narratives to get across their point of view through linguistic devices of factivity and causativity, reordering the narrative structure and selecting (and omitting) events to suit their personal theory of causality (Labov, 1997). In other words, meaning in narratives is derived from the temporal organisation of events selected by the narrator.

All the events selected are important in one way or another because they have been selected by the narrator out of a multitude of other events as “worth noting”, to be included in the narrative (Barthes, 1996). Such information needs to be credibly linked together in order to be acceptable to addressees. Labov (2001) argues that credibility arises from addressees believing that the *reportable event* (what the narrative is all about) did indeed occur in real time. To achieve this, narrators have to introduce a chain of events which explain how the

[9] Labov (1999) later adds a sixth structure, the Abstract (what the narrative is about).

reportable event came about (narrative cohesion) in order to get their theory of causality (coherence) across to their audience.

Studies on narrative coherence owe much to Danes' theory of *thematic progression* which states that information flow in texts is managed by the connective ordering of *Theme* (Given information) and *Rheme* (New Information) (Danes, 1974, as cited in Fries, 1995). Danes proposes three patterns by which information may be structured so as to keep texts coherent: simple linear progression (where the rheme of the first clause becomes the theme of the following sentence), constant continous theme (where the theme of the first clause remains the theme of the clauses following), and theme progression with derived themes (using a hypertheme to which all other clauses relate).

Danes' work forms part of a larger theory of language known as the *Functional Sentence Perspective* (FSP) promoted by the Prague School (founded by Vilem Mathesius and operating in the immediate pre-World War II period), which focused on the functional analysis of sentences, as compared to its formal analysis. FSP (developed by Firbas) proposes that the structures of clauses and sentences function along different perspectives (orientation) according to the purpose of the communication; the interaction of semantic and syntactic factors (in written communication -- word order, context and semantics[10]) drive communication forwards, with each element of meaning having different degrees of communication potential (Svoboda, 2005; Firbas, 2006).

Halliday's (2003) *systemic functional linguistic* theory of language builds on Danes' work, seeing language as a network of systems of meaning (systemic) which evolved out of human social interaction to meet a variety of needs (functional). In his *method of development* of texts, Halliday argues that information flow in texts is managed by the thematic organisation of clauses in first position. Meaning and a particular interpretation of text is achieved by highlighting certain information (the theme) and then carrying it on throughout the rest of the message. Thus, the organisation of thematic clauses has huge implications for the interpretation of the message (Halliday & Mathiessen, 2004).

In Halliday's approach to language, there is no distinction between lexis and grammar; both are meaning-creating. Consequently, word choice reflects the point of view of speakers and their experience of the world, which the speaker then transmits to others. Halliday refers to this *transitivity* as "the set of options whereby the speaker encodes his experience of the

[10] In oral communication, the fourth factor is intonation.

processes of the external world, and of the internal world of his own consciousness, together with the participants in these processes and their attendant circumstances" (Halliday, 1971, p. 119). Thus, Halliday sees language as a social construct influenced by the situation in which it occurs, according to the speaker's communication purpose.

This personalisation of language choice and construction has interesting consequences for the analysis of witness narratives; it suggests that a person's selection of lexis and process in recounting an event will differ from the next person's, even though they have experienced the same event. Labov (1972) also argues that people are so engrossed in the detail of their narratives that they fail to monitor their speech and word selection, which they might otherwise do under other circumstances (Labov, 1972). Labov refers here to oral narratives; however, the same focus on narrative detail at the expense of word monitoring is also likely to apply to written witness statements, making the genre ripe for deception analysis.

1.7.2. Episode Partition in Narratives

The only linguistic research to date on written witness statements made to law enforcement officers involving real life high consequence events is that of Adams & Jarvis (2006). An important feature of the analysis involves dividing narratives into three partitions -- the prologue, the criminal incident, and the conclusion -- based on the opinions of Sapir (1987), Rudacille (1994) and Rabon (1996). A statement subdivided into three balanced partitions is taken to be an indicator of truthfulness, while an imbalance or absence of one or more of the partitions is suggestive of deception.

The issue of narrative partition and how managing information flow might affect its construction has been examined in a non-deception context. Studies into narratives have found that storytellers use segmentation markers as grammatical signals to manage the flow of information in a story and facilitate readers' understanding of events. Prideaux's (1989) work on the role of marked sentence structures in narratives suggests that deviation from the standard sentence construction of *main clause* + *subordinate clause* to that of *subordinate clause* + *main clause* is not just a stylistic preference, but serves the reader as a kind of linguistic signposting.

Prideaux (1989) treats the *main-subordinate constraint* as an instance of markedness, with the usual *main clause* + *subordinate clause* (*MC+SC*) sentence structure being unmarked (more common) and the rarer (less typical) *subordinate clause* + *main clause* (*SC+MC*) structure being marked. He also points out that information contained in the *main clause* + *subordinate clause* structure generally follows the order of events, whereas this order is frequently reversed when the subordinate clause precedes the main clause, increasing processing complexity (*Order of Mention Constraint*).

Halliday (2004) also identifies preposed adverbial clauses and prepositional phrases as marked structures in his work on clause message construction. He argues that in the *Theme-Rheme* construction of sentences (where the theme is *Given* information and the rheme is *New* information), instances where the theme does not overlap with the subject of the sentence should be taken as an instance of markedness. For example, in the sentence -- *The guys started to say insulting and belligerent things before I got to 4th Street* -- the Theme ("The guys") is also the subject of the sentence. However, in the sentence -- *Before I got to 4th Street, the guys started to say insulting and belligerent things* -- the theme ("Before I got to 4th Street") does not overlap with the subject (which remain "the guys").

Studies indicate that the use of marked sentence structures is not random. In Halliday's view, the creation of marked sentence structures is always deliberate and always context sensitive. It is easier for the communicator to choose the unmarked structure, therefore there must be a reason to choose a marked structure instead, and the motivation for that is to be found in the context of the communication (Halliday, 1967; Halliday, 1968). Prideaux (1989) observes that such changes in sentence structures are normally to be found at the beginning of paragraphs in more oral-type written narratives (very infrequently in the paragraph-final position in more stylistically elaborate prose texts).

The placement of such structures is governed by language management requirements which have to be learned, developing with age as children acquire more complex communication competencies (McEwen & Prideaux, 1997). These structures serve as segmentation markers, alerting readers to changes in continuity and the introduction of new discourse packages (Bestgen et al. 2009). More importantly, they signal discontinuity in discourse (Bestgen, 1998).

Unexpected changes in sentence structure draw attention to themselves. Marked sentences are more difficult to process than their unmarked counterparts and slow down readers' processing of the text. In doing so, they highlight the information contained in the sentence, drawing readers' attention to major changes in topic (as in Figure 1 example *1a*) or important incidents (Prideaux & Hogan, 1993) (as in example *2a*), as well as temporal shifts in the narrative (as in example *3a*) (Bestgen & Vonk, 2000; Prideaux, 2000).

1a) Before I got to 4th Street the guys started to say insulting and belligerent things.	1b) The guys started to say insulting and belligerent things before I got to 4th Street.
2a) When she was going through the metal detector she didn't put her bags on the x-ray machine.	2b) She didn't put her bags on the x-ray machine when she was going through the metal detector.
3a) and moments later the ambulance arrived.	3b) The ambulance arrived moments later.

Figure 1: Main-Subordinate Constraint: Marked (a) and Unmarked (b) Sentence Structures

Most importantly, the decision where and when to use these structures rests solely with the narratives' authors and provides insight into their focus when deciding to introduce a thematic break (Halliday, 1967; Bestgen, 1998).

As they read a story, readers construct a mental image of the situation being described (Graesser, Millis & Zwaan, 1997, as cited in Bestgen et al. 2009). Placing marked structures at paragraph-initial positions open new thematic bundles. This keeps the situational information relevant to understanding that part of the story active in reader's short-term memory (Prideaux, 1989). As the situation changes, new thematic bundles introduced by other marked structures help readers update their mental image (Zwaan, Langston & Graesser, 1995, as cited in Bestgen et al. 2009) by closing the previous thematic frame and opening a new one. In more elaborate literary texts, where marked sentence structures are found in a variety of positions, there is less reliance on short-term memory and this allows the main-subordinate constraint to be violated for stylistic purposes (Prideaux, 1989).

Fronted adverbials (adjuncts) operate similarly, identifying thematic change in discourse (Virtanen, 1992, as cited in McEwen & Prideaux, 1997). Virtanen suggests that clause-initial temporal adverbials also serve to highlight *peak episodes* in the narrative, differentiating between events leading up to a climax from the climax itself (Virtanen, 2008).

This structuring of episodes has implications for the identification of deception. Although research indicates that the use of marked sentence structures assist readers in constructing a mental image of the story, no study has explored how such episode constructions reflect the presence of deception. In a truthful story based on actual experience, narrators naturally decide what information to include or leave out, resulting in thematic shifts in time, place and topic while maintaining the continuity and overall cohesion of the narrative as it progresses. However, in deceptive narratives, where deception involves inventing false scenarios, such unconnected details lacking grounding in reality temporally displace the actual timeline. This may result in fragmentation of the storyline because the story elements lack cohesion and the creation of many more episodes than one would expect to find. The same episode fragmentation may also apply in deception by omission, where temporal lacunae (gaps in the time sequence) create new episodes where none are expected. Thus, episode construction to a point where a narrative becomes highly fragmented may be a consequence of deception.

1.8. *Conclusion*

This chapter started some 84 million years ago with deceptive organisms and ends with the complex verbal strategies humans employ to deceive and that lie detectors use to catch them. Humans are genetically programmed to deceive and their psychological orientation and linguistic evolution promote survival of the deceptively fittest. Deception ability, it appears, is an inherent part of survival of the fittest and, thus, has evolved to be adaptive and flexible. Whether deception is genetically programmed or consciously intentional, success (and therefore survival) very much depends on deceivers' strategic adaptations to the circumstances, their ability to respond to feedback and putting themselves in someone else's mindset and selecting the best deceptive strategy.

In humans, this deceptive linguistic flexibility appears to be backed up by the evidence of previous research. No researcher appears to have obtained the same result in every study, either identifying single cues or cue clusters, and this holds for both oral and written deception. Although results are contradictory, Vrij (2008) observes that there appears to be general trends in oral deception, with more researchers finding that deceivers use less self-references, more negation, more generalising, and shorter responses. Since the majority of deception studies are undertaken with students lying about trivial matters, how valid these cues really are, and how they compare with real life high stakes deception, is difficult to assess.

How oral cues apply to textual deception is also uncertain. Given the diversity of contexts in CMC experiments and the inconsistencies in findings between them, no meaningful trend in textual deception cues has yet been identified. Word quantity appears to indicate the opposite in synchronous (less) and asynchronous (more) deception, while deceptive language complexity measurements vary according to the properties of the CMC messaging and the task performed. At best, what can be said is that word quantity appears not to translate across the media, with oral deceivers generally saying less and textual deceivers generally writing more than their truth telling counterparts.

It is impossible to say anything about linguistic cues in high stakes textual monologue deception as very little exploration has been undertaken in this field. How cues in interactive deception (real and virtual) compare with textual monologues, in particular, textual monologues involving high consequence deception, may be described once the linguistic cues to such deception have themselves been identified. To date, this has not been addressed. This study contributes towards filling the gap in that knowledge base and providing a strong foundation for informed deception detection in written text.

CHAPTER 2

2. The Study: Cues to Deception in Written Witness Statements

2.1. *Theoretical Background*

This study was originally inspired by the requirement for intent-based standards of proof for fraud prosecution in court. Legal statutes worldwide require convincing proof of fraudulent intent in order to prosecute and hold that the misrepresentation of information in the honest belief that it is true (no matter how unreasonable that belief) is not fraudulent. This requirement to distinguish between deliberate and accidental deception has given rise to a massive industry geared towards the identification of deception in a forensic context.

2.1.1. Detecting Truth, Detecting Lies, and Credibility Assessment

Getting to the truth has long been a social issue. In early societies, truthfulness and lying were perceived as moral conditions. Truth was a *revealed* truth as provided by God through the Church. The way a person behaved dictated whether he or she was lying or telling the truth, irrespective of what the person said. In English courts in medieval times, such dilemmas were tested by ordeals of fire and water, the general belief being that death was the consequence of sinful lying while God would protect the truthful individual.

Between the 13^{th} and 17^{th} century, pain (arising from torture) was perceived as a source of truth (Cohen, 2010). Truth had to be spontaneous; the real truth was that which was dragged out as a result of inflicted pain rather than the personal truth that was composed in a person's mind. Although man's will resisted telling the truth, truth and deception could be identified by reading involuntary body signals such as pallor, which was taken to be an indication of guilty knowledge (Silverman, 2010). In the 1600s, the idea that the truth could be arrived at in court by detailed questioning of the person and analysis of the evidence first made its appearance and led to the practice of cross-examination and adversarial debate that underpins the British legal system today.

However, in the 19^{th} century, the idea that lying could be identified by the involuntary behaviour of deceptive individuals again made its appearance; but instead of a search for truth, mindsets shifted to the detection of deception. The identification of deception and criminal personalities became fashionable with the development of new scientific techniques such as the *plethysmograph* and the *sphygmograph* which worked on the assumption that lying affected deceivers' heart rate and blood pressure.[11] This was followed by streams of new *machines* that monitored physical behaviour such as galvanic skin response, muscular activity, breathing rate and pulse rate in the belief that changes in their measurement identified deceptive behaviour. These machines became the foundations for the modern polygraph.

Such developments were eagerly embraced by law enforcement agencies which saw the new science of lie detection as replacing the need for police interrogation and, potentially, judges and jury service in determination of guilt -- "there will be no jury, no horde of detectives and witnesses, no charges and counter charges, and no attorney for the defence. These impediments of our courts will be unnecessary. The State will merely submit all suspects in a case to the tests of scientific instruments"(The New York Times, 1911).

As lie detecting technologies developed, identifying reliability and validity measurements that made them good enough to serve as evidence for court became an increasing problem. In 1923, the defence counsel of James Alphonso Frye attempted to introduce polygraph results as evidence of his innocence in a Washington DC (USA) court. The Court rejected the application, agreeing with the prosecution's argument that, "while the courts will go a long way in admitting expert testimony, deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs" (*Frye v United States,* 1923, Court of Appeals of District of Columbia).

The Frye case instituted the requirement that, for evidence to be acceptable to the Court, it had to enjoy *general acceptance* in the scientific community. This remained the majority rule in US courts until 1993 when it was rejected in favour of *Daubert v Merrel Dow Pharmaceuticals Inc*. The Daubert test introduced a requirement for independent judicial assessment of *evidentiary reliability* which trial judges could consider, such as evidence of testability and known or potential rates of error, in addition to peer review and general acceptance of the methodology within the relevant scientific community, none of which have been met by the polygraph.

[11] The author Daniel Defoe also thought that deception could be identified through monitoring heart rate in his 1730 publication, *An Effectual Scheme for the Immediate Preventing of Street Robberies and Suppressing All Other Disorders of the Night,* addressed to the Lord Mayor of London.

The Law Commission in the UK favours a more Daubert-style approach and suggests that modifications to criminal procedure[12] and how evidence is presented would be the best way forward to reducing miscarriages of justice resulting from failings in expert evidence (Law Commission, 2009). In contrast, the Appeal Court has consistently chosen to reject the *Daubert* test in dealing with admissibility of evidence, supporting the assertion that there "is no single test which can provide a threshold for admissibility in all cases"(*R v Harris, Rock, Cherry and Faulder* [2005] EWCA Crim 1980).

Although the polygraph is not accepted as evidence in UK courts and has previously not been used by UK police, Hertfordshire Police trialled its use as a lie detection tool in the first ever pre-conviction testing of (sex) offenders in 2011, with further trials to commence in April 2012[13]. This is a retrograde step as the polygraph functions as an old fashioned instrument of torture which works by instilling fear into its subjects in order to extract confessions. No real life study on the effectiveness of polygraphs has been published to my knowledge but general literature refers to its unacceptably high false-positive rate. A 1986 study found that most polygraph studies which reported very high success rates had serious methodological flaws and that truthful persons labelled as liars by polygraph testing would outnumber correctly identified liars (Brett, Phillips & Beary, 1986).

Techniques have also been promoted for assessing the credibility of individuals when there is no evidence available other that the testimony of the person. As opposed to determining whether an individual is being truthful or deceptive, *credibility assessment* revolves around how believable a person is perceived to be. First developed in the 1950s to assess the reliability of children as witnesses in sex abuse cases for court, Statement Validity Assessment (SVA) is the most well known procedure. It consists of four stages, where case file information is examined, followed by an interview stage where information is extracted from the child witness and is credibility assessed using 19 criteria based on the Undeutsch Hypothesis at the CBCA stage; further assessment of the witness occurs in the final stage using a Validity checklist.

---

[12] Although the Law Commission stresses that their Consultation paper only applies to evidence and not practice. (Law Com No 190: 1.12)
[13] Update 20th July 2012 - The Ministry of Justice is to allow probation officers to use polygraph testing to manage paroled sexual offenders. http://www.telegraph.co.uk/news/uknews/crime/9414112/Sex-offenders-will-take-lie-detector-tests-to-keep-a-check-on-them.html

CBCA is now used by police and other investigators during interviews with adult suspects to determine the veracity of their information. Although studies have suggested that CBCA can successfully judge the truthfulness of statements (Sporer, 1997; Vrij, 2008) CBCA was not developed originally to distinguish truthful from deceptive accounts, and neither was it meant to be used independently of the SVA process. A problem associated with using CBCA as a truth/lie detection tool is that it cannot distinguish between accounts that are partially experienced with non-experienced elements inserted in it (Akehurst, Manton & Quandte, 2011). Thus, its strength remains as a credibility, rather than a veracity, assessment tool.

2.1.2. Linguistic Cues and Textual Communication Contexts

In recent years, research into how deceivers behave linguistically when they lie in writing has centred on developing automated deception detection strategies to analyse the masses of text produced by online communication. Given the implications this has for national security, Government departments such as those dealing with military defence and border security have been keen to support this research. Such automated approaches have successfully identified differences between false and truthful communications, whether they be FtF (Zhou et al. 2004a; Zhou et al. 2004b; Hancock, Curry, Goorha & Woodworth, 2008) or CMC (Bond & Lee, 2005; Burgoon & Qin, 2006); however, the linguistic cues which distinguish deceptive from actual accounts differ across the studies.

Such research shows that deception appears so complex that no single behaviour can be uniquely associated with it (Vrij, 2000; DePaulo et al. 2003; Memon, Vrij & Bull, 2003; Vrij, 2008). This raises questions as to how deception affects linguistic markers in the types of textual communication produced by different media. Do linguistic cues differ between different types of written deception, such as when lying in the interpersonal synchronous context of CMC messaging or in the more asynchronous context of email? Studies so far suggest that they do (Burgoon et al. 2003; Zhou et al. 2003; Hancock et al. 2004; Zhou et al. 2004b; Hancock et al. 2005; Zhou & Zhang, 2007; Zhou & Sung, 2008; Hancock et al. 2008). If this is indeed the case, can we expect additional differences between these interactive messaging contexts and the monologue textual context of written witness statements?

Zhou & Sung (2008) attribute contradictions in their findings regarding deceivers' linguistic diversity, quantity and immediacy in instant messaging, as compared with other online communication studies such as email, as possibly being due to difference in media. "Email is considered a leaner communication medium in comparison to instant messaging in terms of the pace of feedback and the level of interactivity" (Zhou & Sung, 2008, p. 6).

Instant messaging being a dialogue (albeit a textual one), both sender and addressee are expected to constantly acknowledge each other's messages to show they have understood what the other is attempting to communicate. This is different for textual monologues (such as email), where no grounding is necessary as the sender does not interact with an addressee and the speed of feedback is considerably slower than that of instant messaging.

Consequently, one would expect written witness statements to be an even leaner communication medium than email. Generally, witness statements are intended for more general consumption (other police officers, solicitors, Court officers etc) than a single addressee and feedback to the statement writer would only come much later at the investigative interview stage. Given these differences, it is therefore reasonable to expect that deception cues in written statements will differ from those identified in computer-mediated communication.

Can we expect deception cues to be stronger in deceptive witness statements than interactive deceptive text communications? Theoretically, yes. DePaulo et al. (2003) argue that lying is such an unexceptional part of social interaction in everyday life, causing little shame or guilt to the deceiver, which results in deception cues being weak and subtle and having little impact on language. To trigger the occurrence of more obvious linguistic cues, deceivers need to be highly motivated to succeed with their lies (DePaulo & Kirkendol's (1989) *motivational impairment effect*).

However, not all motivations are equal. Instrumental motivations (financial or material reward) produce cues that are as weak as no-motivation deceptions, while identity-related motivations (involving those that affect the public awareness and self-confidence of the deceiver) produce cues that are significantly stronger than chance (DePaulo et al. 2003). This requires that the consequences of being discovered attempting to deceive should result in such severe negative social and/or judicial repercussions that deceivers' self-esteem, public standing, liberty, and perhaps even life will be threatened. Such repercussions might motivate deceivers more highly to succeed in their deception, increasing emotional and cognitive stress to such an extent that, in so doing, their language is affected in some way. The problem is that no one quite knows what cues to look for.

2.2. *Theoretical Perspectives of Deception and Their Cues*

The identification of cues characteristic of deception has long been associated with certain behaviours that deceivers are thought to default to when they lie. Deceivers are said to appear *less forthcoming*, *less pleasant*, and *more tense* (DePaulo et al. 2003) as a result of the emotional and regulatory burden they bear when lying which is reflected in their physical and linguistic behaviour. While there is empirical evidence that behaviour does change during deception (Vrij & Mann, 2001), informed deceivers may be able to control certain behaviours successfully and so evade the scrutiny of lie catchers looking for such cues (Mann, Vrij & Bull, 2002).

Researchers have identified certain perspectives -- emotion, cognitive load, and attempted behavioural control (Memon, Vrij & Bull, 2003) and lack of embracement (Vrij, 2008) -- which they believe underpin physical and linguistic cues to deception. Although these processes are hypothetical and identified retrospectively to explain differences in deceptive behaviour between deceivers and truth tellers (Memon, Vrij & Bull, 2003), evidence exists that deceivers do experience some of these processes more than truth tellers (Vrij, Semin & Bull, 1996; Vrij & Mann, 2001). However, while such behaviour may arise as a result of experiencing processes like cognitive complexity, strong emotions and the sort of attempted control associated with deception, the behaviours are by themselves not indicators of deception; merely that the processes are active in the individual.

2.2.1. Emotion

DePaulo et al.'s (2002) description of deceivers' language being *less pleasant* arises from research which suggests that emotions associated with deception such as anxiety and guilt lead to fear cues such as negative emotions or negative effect which manifest themselves in verbal behaviour (Knapp et al. 1974; DePaulo, Rosenthal, Rosenkrantz & Green, 1982b; Newman et al. 2003; Zhou et al. 2004a). However, Vrij, Ennis, Farman & Mann (2010) argue that tellers of simple lies are only marginally more tense than truth tellers and that labelling them as 'nervous' is an exaggeration; although it may be that as the seriousness of a lie increases in line with deceivers' attempts to avoid getting caught, so may their level of tenseness. However, Vrij & Mann (2001) report this not to be the case in their study involving the interview of a murder suspect (who was subsequently convicted of murder). While the suspect was more nervous when lying than when telling the truth, he did not exhibit nervous behaviour for so high stake a situation. In this case, the individual was a seasoned criminal, so it may be that experience tempers leakage of nervous behaviour.

Fear cues may also surface when truth tellers worry about not being believed. This results in truth tellers experiencing similar processes to liars and leads to their negative behaviour being interpreted as deceptive. Such misguided interpretation of nervous behaviour results in the *Othello Error* (Ekman, 2001), named after the Shakespeare play in which Othello murders his wife, Desdemona, having misread her emotional behaviour as a sign of guilt of the infidelity of which she is accused. Indeed, in a review of polygraph tests, Vrij (2000) reports that 21% of innocent people are wrongly accused of lying as a result of truth tellers experiencing fear during testing. Fear of not being believed leads both truth tellers and deceivers to make more of an effort to control what they believe to be nervous behaviour (Vrij, Mann, Leal & Granhag, 2010) and try to be more convincing (Bond & Fahey, 1987), resulting in unnatural behaviour which may be misinterpreted by deception detectors.

Vrij (2008) categorises Negation under the *emotion* theoretical perspective, as guilt and fear associated with deception may leak into language as negative comments (Knapp et al. 1974; Zuckerman et al. 2001; Vrij 2000). Included in negative comments is the use of *negative affect*, words reflecting negative emotion and anxiety. However, given the Othello Error, the use of Negation as a deception cue in an emotional sense is unhelpful. Instead, Negation would be better employed as an indicator of *lack of specificity* (as described by Weiner & Mehrabian, 1968), where it is used to describe what did not happen or say *what is not* without clarifying *what is*. In this context, Negation should fall under DePaulo et al.'s (2003) description of deceivers being *less forthcoming* (Cognitive Effort) rather than *less pleasant*.

2.2.2. Cognitive Effort

Zuckerman et al. (1981) first made the association between cognitive effort and deception. They argue that deceivers use up greater cognitive resources than truth tellers in order to come up with a more plausible deceptive story. However, this is not always the case as telling a well-rehearsed lie about a simple matter can be just as cognitively easy as telling the truth (Vrij, 2000). Deceivers become more tense managing their cognitive loading as the seriousness of the lie increases; thus, the more effort deceivers put into their deception, the tenser they become (DePaulo et al. 2003; Vrij et al. 2010).

Vrij (2008) suggests that high cognitive loading may result in non-immediacy and ambiguity, characterised by fewer self-references and shorter statements with less detail. Pronouns remain the preferred linguistic measure of immediacy and conviction, with use of self-references being the strongest measurement of association (and honesty) and Third Person Pronouns the measure of distancing (non-immediacy). Although Vrij (2008) believes that the association between immediacy and deception is not as strong as the data suggests, previous research supports a negative correlation between self-references and deception (Burgoon et al. 1996a; Burgoon et al. 1996b; DePaulo et al. 1982b; Ebesu & Miller, 1994; Newman et al. 2003).

The association between short responses and deception is also well-documented (Ebesu & Miller, 1994; Vrij, Edward, Roberts & Bull, 2000; Newman et al. 2003; Burgoon & Qin, 2006; Zhou & Zhang, 2006). Shorter responses potentially signal the increased cognitive load deceivers have to contend with when managing their lies, resulting in less detail, or they may simply reflect a reticent attitude towards information disclosure.

However, this is not always the case, as some studies show that deception is also associated with verbose responses (Anolli & Ciceri, 1997; Anolli, Balconi & Ciceri, 2002; Burgoon et al. 1996a; Burgoon et al. 2003; Zhou et al. 2004a; Hancock et al. 2004; Hancock et al. 2005; Zhou & Zhang, 2007). Zhou et al.'s (2004a) studies produce contrasting results, with deceivers using fewer words in the first part of their experiment and more words in the second part.

There are difficulties associated with linguistically measuring lack-of-detail and response lengths. Low lexical diversity[14] resulting from shorter sentences (due to deceivers carefully considering the information they provide) is traditionally associated with deceptive utterances (Burgoon et al. 2003; Zhou et al. 2004b; Hollien, 1990, as cited in Dilmon, 2009). However, being careful about one's choice of words may also lead deceivers to using different words, leading to higher lexical diversity (Carpenter, 1981, as cited in Vrij, 2008). Low lexical diversity is also associated with truthfulness, as truth tellers often repeat information they previously provided as that is all the truth they know (Larcker & Zakolyukina, 2010); however, deceivers also repeat information in order to stress its credibility (Zhou et al. 2003). High lexical diversity is associated with deceptive statements when deceivers are verbose and provide much irrelevant information to create ambiguity, resulting in an increase in unique words (Colwell et al. 2002; Zhou & Sung, 2008). Vrij (2008), however, found no association between lexical diversity and deception.

[14] Lexical diversity is measured using Type-Token Ratio, calculated by dividing the number of unique words in a statement by the total number of words in the statement.

2.2.3. Attempted Behavioural Control

Both truth tellers and deceivers manage their behaviour in order to create a favourable impression with other people. However, trying to regulate behaviour brings with it certain dangers as the motivation to be believed makes people behave in such a manner that they come across as less plausible, irrespective of whether they are lying or telling the truth (Bond & DePaulo, 2006).

Thus, trying to correct deceptive behaviour may instead inadvertently create other deceptive cues as the cognitive burden of attempting to appear honest and truthful becomes more demanding (DePaulo & Kirkendol, 1989). Although deceivers may want to appear cooperative and provide information regarding a particular event, they are unable to do so because they lack the experience and risk contradicting themselves or being disproved if they provide too much information (Hartwig et al. 2005). Therefore, deceivers may keep their statements short; but they may also attempt to provide alternative information in exchange for that which they cannot provide, resulting in verbose and ambiguous statements (Anolli, Balconi & Ciceri, 2002).

2.2.4. Lack of Embracement

Without actual experience of the false scenarios they provide, deceivers lack the conviction of their truth teller counterparts and fail to embrace fully their deception (Larcker & Zakolyukina, 2010). Deceivers are able to step back from fully committing to their lie by using more tentative, vague and generalising terms (Newman et al. 2003; Bond & Lee, 2005; Adams & Jarvis, 2006); they may provide shorter responses (Ebesu & Miller, 1994; Vrij, Edward, Roberts & Bull, 2000; Newman et al. 2003; Zhou et al. 2004a; Burgoon & Qin, 2006; Zhou & Zhang, 2006) and use less self-references (Burgoon et al. 1996a; Burgoon et al. 1996b; DePaulo et al. 1982b; Ebesu & Miller, 1994; Newman et al. 2003).

However, research suggests there is only a weak positive correlation between generalising (identified linguistically as the use of non-specific language, such as levelling words e.g. *all*, *every* etc, passive constructions and modal verbs) and deception (Knapp et al. 1974; Cody, Marston & Foster, 1984; Cody, Lee & Chao, 1989), and DePaulo et al. (2003) found no support for its use as a deception cue.

2.3. *Development of Hypotheses*

In contrast to other studies which use poor simulations of deception in laboratory environments or real life but low-stake deception, this study makes use of high consequence deception in real life contexts, examining witness statements written by individuals reporting serious crime such as rape, arson, kidnapping, aggravated assault, murder, manslaughter, and theft. This study sets out to examine the predictive power of cues arising from high stake textual deception by, first, extracting linguistic features from a test group of deceptive and truthful statements and second, applying them to a second group of statements in a double blind study. No other deception study has undertaken a double blind study or even a blind study in its research. In this respect, this study is unique.

This study is also the first to examine deception from an episode perspective as determined by the statements' own authors. All previous uninterrupted monologue statements (oral and written) were examined either in their entirety or, in the case of experiments involving *statement analysis*, artificially subdivided (according to analysts' opinion as to where the *prologue*, *main event*, and *epilogue* begin and end).

To date, only one study (Adams & Jarvis, 2006) to my knowledge[15] has examined deception cues in real world author-written witness statements relating to high stake crime. This study retrospectively analysed 60 witness statements written by individuals involved in serious criminal events using statement analysis. However, the status of the statements was already known to the analysts and no attempt was made to predict deception using the cues identified.

The term *statement analysis* refers to a variety of analysis techniques such as Scientific Content Analysis (SCAN) (Sapir, 1987) and Investigative Discourse Analysis (IDT) (Rabon, 1996) popular with law enforcement agencies. The techniques claim that the absence or presence of pronouns or the selection or variation of word choice or tense potentially identifies deception. For example, a bank teller incriminates herself in a theft when she changes from using "currency" to "money" (SCAN); a woman incriminates herself in her husband's murder when she changes the referent from "the money" to "my money" (IDA). SCAN also claims to be cross-cultural and can be applied to any language.

[15] Fuller et al. (2008) analysed 163 written witness statements from personnel in two military bases involved in "high-stakes" crime. However, these included "crimes" such as being caught driving erratically.

To date, no empirical evidence exists to support their claims. Specific criticisms made of SCAN include lack of standardised assessment methodology (which results in different persons focusing on different criteria when analysing the same statement) and the absence of guidance in determining what weighting should be attached to the presence or absence of the various cues (Smith, 2001; Vrij, 2008). Shuy (1998) criticises its application to language without any consideration for cultural and socio-economic differences that may exist[16]. A recent study by Nahari et al. (2012) finds no support for SCAN and concludes that the "findings do not justify the use of SCAN for lie detection purposes in real life practice" (Nahari et al. 2012, p. 75). The continuing use of such unproven and unsupported lie detection techniques in police and investigative operations, when their unreliability has been demonstrated by academia, goes against all ethical principles promoted in responsible policing (Heydon, 2011).

Witness statements are the ideal textual material to work on as they are the product of individuals with firsthand experience of a real world event deception. These persons would be highly motivated to produce believable and convincing deceptive statements due to the seriousness of the consequences to their personal reputation and well-being should they be found lying. Such motivation for their deception to be believed would be much higher than that found in laboratory based deception simulations, which are rarely consequential and cannot replicate the stimuli of real life deception.

Thus, given the self-presentational implications should deceivers be caught lying and the incentive to preserve their reputation and liberty, it is expected that linguistic cues will be stronger and occur more often in the language of deceptive statements than would otherwise occur in a laboratory environment where no such impetus exists. This motivation to succeed with deception is a fundamental part of this study, which relies on the magnification of cues which would otherwise be absent or very faint in inconsequential lying (DePaulo et al. 2003).

2.4. *Linguistic Cue Selection*

This study is consistent with others in hypothesising that the linguistic styles of truth tellers and deceivers differ from each other. It also hypothesises that cues in combination make better diagnostic markers (in agreement with DePaulo et al. 2003) than cues in isolation, and that the degree of use of such cues is a measurable feature of textual deception.

[16] SCAN is used in countries such as Australia, Belgium, Canada, Israel, Mexico, UK, US, the Netherlands, Qatar, Singapore, and South Africa (Nahari et al. 2011).

A wide scale literature review was undertaken to identify the most promising cues suitable for textual deception. As seen in this review, no single cue or combination of cues emerges as consistently indicative of deception across media, or even within verbal and textual contexts. So far, no cues have been identified specifically for textual deception; the only other study into high stakes textual deception (Adams & Jarvis, 2006) identifies some support for an association between deception and equivocation and negation consistent with some trends. Neither can linguistic behavioural patterns be assumed to increase in line with the seriousness of the deception (Porter & ten Brinke, 2010), so there is little assurance that cues identified in simulated low stake deception apply to high stake lying. Thus, there is little guidance in the literature for cue selection.

Consequently, cues were systematically selected to meet the following criteria. First, cue categories were identified on the basis of their association with deception in previous studies which establish to a general extent the effectiveness of the cue. Second, cue categories were tightly defined for the purpose of this study; third, cues were identified for distinctiveness (to be picked out easily and differentiated from other cues) and modelling capacity (easily quantifiable); fourth, cues were selected to be as sociolinguistically neutral as possible in the context of American-English native speakers.

Certain cue categories developed for interview and interrogation contexts such as quantity of detail and temporal and spatial information were excluded from the analysis as they were difficult to implement.

This study did not seek to assess veracity cues or predict truthfulness, although cues previously associated with truth telling, like First Person Singular Pronouns, were analysed in order to explore their collective and individual interaction with deception cues.

Based on the literature review, linguistic cues selected for analysis were: Amount of Words, First Person Singular Pronouns, Third Person Pronouns, Vague Pronoun References, Verb Strings, Negation, and Cognitive Verbs.

Word lists were created for each cue category by subjectively identifying the relevant words in individual statements and then counting them manually.

2.4.1. Amount of Words

Previous literature generally reports that deceivers say less. However, Zhou et al. (2004c) point out that linguistic patterns change according to the type of statements being analysed, which goes some way towards explaining the contradictory findings relating to the amount of word use in deception. In textual contexts, previous literature reports that lying in interactive CMC results in increased word use as deceivers use rich and expressive language to convince their addressees of their sincerity instead of limiting themselves to simple facts. In criminal witness statement analysis, where much depends on the recollection of facts, deceivers may prefer to say less as they would be unable to provide the same quantity of detail and information as truth tellers. On the other hand, with time to think about and prepare their statements, deceivers are able to provide alternative information to compensate for that which they cannot give. Thus, they may offer their opinions or explain why they performed particular actions, subjective information which is difficult to verify. They may also concentrate and expand on truthful information into which they insert their lies, hoping that they will be difficult to spot. Therefore, it is believed that deceivers will be more verbose than truth tellers.

Hypothesis 1 - Verbosity is positively correlated with deception. Deceivers use more words in their Statements than truth tellers.

a) Deceivers will use longer clauses in Deceptive Statements than in Truthful Statements.
b) In Deceptive Statements, Deceptive Episodes will contain longer clauses than Truthful Episodes.

A *clause* is defined as a group of words that does not necessarily constitute a sentence, consisting of a subject (which may be implied) and a predicate.

2.4.2. Pronouns

Pronouns have had a long association with language-based deception detection. DePaulo et al.'s (2003) review of studies relating to verbal cues associated with deception identifies a general (albeit weak) trend wherein liars refer to themselves less often than truth tellers. Theoretically, this reduction in self-references should be accompanied by an increase in *other* oriented references such as Third Person Pronouns (Knapp et al. 1974) as deceivers use them to refer to other persons, things or events in the process of moving focus elsewhere away from themselves. After all, blaming someone else is perhaps one of the oldest deception strategies known to humans.

Curiously, Newman et al. (2003) report in their study an unexpected corresponding reduction in Third Person Pronouns as well as First Person Pronouns, which is inconsistent with previous research. Newman et al. attribute this reduction in Third Person Pronouns to being the result of the topic, abortion attitudes. They hypothesise that perhaps those who lied about their opinions on abortion preferred to refer to specific people rather than use pronoun references; referring to concrete and specific people increases the credibility of their information, while pronoun references are more abstract and less convincing. Or it may simply be that Newman et al.'s deception model was poor and involved low stake lying.

This study examines only First Person Singular Pronouns (*I*, *Me*, *My*, *Mine*) and not all First Person Pronouns because of ambiguity in the focus of plural pronouns. The interpretation of First Person Plural Pronouns is heavily context dependent. *We* and *Our* can be interpreted as positive indicators of group identity, which includes the author in the group (Pennebaker & Lay, 2002, as cited in Pennebaker, Mehl & Niederhoffer, 2003). However, it also has negative connotations when deceivers use the pronouns to share responsibility for their actions by referring to themselves acting in or hiding behind their association with others. As a figure of speech, the pronouns can even be used in a manner that excludes the author from the group[17] (Tausczik & Pennebaker, 2010), in spite of the overt association.

The individual pronouns *I, Me* and *My* were also examined in this study with a view towards exploring how they interact with each other during deception, and establishing whether deceivers are predisposed towards using any one of them over the other. Previous studies have tended to look at First Person Singular Pronouns collectively, as if all the pronouns in the group are equally weighted. However, research into pronoun use as an indicator of mental health by Campbell & Pennebaker (2003) suggests that, in fact, pronouns are not all weighted equally and an individual's perception may influence choice of one or the other. Indeed, a comparison between the active *I* and the passive *Me* identifies two very different perceptions by authors of the roles they play in a particular scenario -- as agent of the action, and as recipient of the action. In the first instance, authors actively initiate the behaviour, while in the second, they step back from focusing on their actions and distance themselves by describing what is being done to them, being the victim of an action initiated by someone else.

[17] For example, when a supervisor tell his graduate student '*We need to analyse this data*', he means '*you the student*' rather than '*you and I*' (Tausczik & Pennebaker, 2010).

Second Person Pronouns are not explored in this study. Like Third Person Pronouns, *You* pronouns act as markers of social awareness (Pennebaker, Mehl & Niederhoffer, 2003) and the extent to which authors' foci is on others rather than themselves. However, in the context of witness statements, where there is no one to address as *You*, the pronoun is redundant in any case.

Therefore, this study uses First Person Singular and Third Person Pronouns as measures of embracement and distancing, and hypothesises that deception is negatively correlated with First Person Singular Pronouns and positively correlated with Third Person Pronouns. No hypothesis was put forward regarding differences in weighting between First Person Singular Pronouns, although *I*, *Me*, and *My* were assessed individually as well.

Hypothesis 2 - The use of First Person Singular Pronouns is negatively correlated with deception. Deceivers refer to themselves in their Statements less often than truth tellers.

a) Deceptive Statements will contain a lower rate of First Person Singular Pronouns than Truthful Statements.
b) In Deceptive Statements, Deceptive Episodes will contain a lower rate of First Person Singular Pronouns than Truthful Episodes.

The First Person Singular Pronouns analysed collectively are: *I, Me*/*Myself,* and *My*/*Mine*. The pronouns *I*, *Me,* and *My* are also analysed individually in order to explore differences in weighting between them, although no hypothesis is put forward regarding their performance as no information is available on it. Therefore, this study is the first to analyse differences in weighting of individual self-references and explore any association with deception.

Hypothesis 3 - The use of Third Person Pronouns is positively correlated with deception. Deceivers refer to others more often in their Statements than truth tellers.

a) Deceptive Statements will contain a higher rate of Third Person Pronouns than Truthful Statements.
b) In Deceptive Statements, Deceptive Episodes will contain a higher rate of Third Person Pronouns than Truthful Episodes.

The pronouns analysed collectively are: *He, She, Him, His, Her, They, Them, Their,* and all variations e.g. *Herself, Themselves* etc.

2.4.3. Vague Pronoun References

In this study, the category of Vague Pronoun References applies to pronouns that generate non-specific language, characteristic of deceivers' attempts to avoid detail that could otherwise be verified easily. This lack of specificity may also arise as a result of the cognitive burden associated with high stake lying. It may be beyond the ability of the average deceiver to construct an imaginary scenario populated with the sort of detail that might be difficult to remember due to the stress of lying. Pronouns such as *some*, *someone*, or *everything* are vague references to unspecified people and words that deceivers can safely use to create an alternative ambiguous reality or safely generalise.

This is the first study to examine the association between generalising pronouns and deception in this narrow context. DePaulo et al.'s 2003 review found no association between generalised statements and deception. However, *generalising terms* in previous studies largely referred to *Leveller* words such as *always*, *never*, *nobody* or *everybody* (Vrij, 2008). Zhou et al. (2004b) define generalising terms according to Weiner & Mehrabian (1968) as referring "to a class of persons or objects that includes the person (or object)" (p.94). This broad definition captures anything suggesting inclusiveness.[18] Zhou et al. (2004b) report no association between generalising terms and deception, although Zhou et al. (2003) report mixed results (less generalising terms than truthful email senders but more than truthful email receivers).

This study excludes Levellers as a category and redistributes relevant words to other categories (such as *never* and *nobody* to Negation), while retaining generalising words such as *someone* and *everybody* as Vague Pronoun References. As well as a generalising feature, Vague Pronoun References is an indicator of *other* orientated focus traditionally associated with Third Person Pronouns, which deceivers may prefer to use to create non-immediacy. Consequently, this study hypothesises that Vague Pronoun References will be correlated positively with deception.

Hypothesis 4 - The use of Vague Pronoun References is positively correlated with deception. Deceivers are more vague in their use of references in their Statements than truth tellers.

[18] According to Weiner & Mehrabian (1968), this included references such as *entire*, *books*, and *high school girls*.

a) Deceptive Statements will contain a higher rate of Vague Pronoun References than Truthful Statements.
b) In Deceptive Statements, Deceptive Episodes will contain a higher rate of Vague Pronoun References than Truthful Episodes.

Vague Pronoun References are defined as indefinite pronouns that refer to non-specific people and things. The references included in this definition are: *someone, something, everyone, everything*, *one*, *any*, *some*, and *thing*(*s*).

2.4.4. Verb Strings

The use of Verb Strings as an indicator of ambiguity and lack of embracement is another linguistic feature not previously explored as a deception cue. Verb Strings consist of two or more verbs functioning as a single verb where the supporting verbs modify the main verb in some way, implying an action or retracting an implied action. This creates ambiguity as to what is actually going on and may signal authors' lack of conviction to the information they are providing, resulting in a less plausible story. For example, in the Verb Strings *needed to see* and *started yelling*, while an action is proposed, it evades confirmation as to what was done or whether the action was completed. This opens up alternative possibilities as to what actually did happen.

As with Vague Pronoun References, the Verb String is a recharacterisation of previously identified cues at times found to be associated with deception, such as modal verbs, passive voice, modifiers, and increased verb use. These cues contribute towards making the message unclear and non-immediate while, at the same time, providing information that appears complete. Weiner & Mehrabian (1986) report that verbal non-immediacy results in making the link between actor and action less clear. Verb Strings do exactly that, functioning as a type of subjective language suggesting unreality or action that has yet to be performed (wishing, possibility, necessity, intention) or completed. Thus, the concept of unclear language is incorporated into Verb Strings without having to analyse other unpromising cues.

On the basis that deceivers are more non-immediate and ambiguous than truth tellers, this study hypothesises that deception will be positively correlated with increased use of Verb Strings.

Hypothesis 5 - The use of Verb Strings is positively correlated with deception. Deceivers use more ambiguous language than truth tellers to describe events in their Statements.

a) Deceptive Statements will contain a higher rate of Verb Strings than Truthful Statements.
b) In Deceptive Statements, Deceptive Episodes will contain a higher rate of Verb Strings than Truthful Episodes.

A Verb String is defined as a combination of two or more verbs acting together to play the role of a single verb e.g. *started to walk, need to retrieve, trying to go down*.

2.4.5. Negation

In this study, Negation refers to a denial of something, rather than an indicator of emotional leakage. Coulthard (1992, as cited in Adams & Jarvis, 2006) finds that in both spoken and written discourse, the majority of clauses tend to be affirmative, what *is* rather than what *is not*. Therefore, clauses containing Negation are taken to be a rarer marked form (than affirmations) serving a specific function. Given that people generally try to be informative, and negative sentences tend to be less informative than their affirmative counterparts (Leech, 1983), then the context in which Negation is used must be somehow relevant to the communication (Israel, 2004).

Considering that the instruction given to those writing witness statements is to state *what happened*, providing information about what did not happen raises questions as to what did occur and why the author has chosen to move the story forward by using the negative. “One does not normally deny something unless one thinks that someone might believe it”[19] (Israel, 2004, p. 706),

For example, the negative assertion *They got more belligerent and insulting*. *I* ***don’t*** *recall what was said* allows the author to avoid providing more detailed information in support of his claim that his attackers were being *belligerent and insulting*; the author tries to be cooperative but is less forthcoming about the specifics. Negation here anticipates any request to clarify this point further.

Negative statements as an indicator of deception are only weakly supported in DePaulo et al.’s (2003) review. However, the studies in the review included analysis of negative effect, and no studies were conducted on real life high stake monologue text statements. The only two studies exploring Negation in a textual context are those of Newman et al. (2003) (low stake lying) and Adams & Jarvis (2006) (high stake lying), and both found a positive

[19] Reproduced with permission from John Wiley & Sons.

association with deception, as did Hancock et al. (2005) and Toma & Hancock (2010) in their low stake lying online. Consequently, this study hypothesises that the use of Negation will be positively correlated with deception.

Hypothesis 6 - The use of Negation is positively correlated with deception. Deceivers create ambiguity by providing clarification in their Statements through the use of denial.

a) Deceptive Statements will contain a higher rate of Negation than Truthful Statements.
b) In Deceptive Statements, Deceptive Episodes will contain a higher rate of Negation than Truthful Episodes.

Negation is defined as a word expressing a single negation, such as *no, not, never*, *nothing*, *nobody, no one* etc, as well as containing adjectives prefixed by *un-* expressing a negation e.g. *I was unsuccessful*.

2.4.6. Cognitive Verbs

The use of Cognitive Verbs as a lie detection tool is taken from the Reality Monitoring approach which states that memories derived from actual experience (perceived through the senses) will differ from those that are internally generated (from imagination) (Johnson & Raye, 1981; Johnson et al. 1988). An indicator of memory derived from imagination is the presence of words reflecting thought and reason, the cognitive processes involved in the creation of such memories.

There does not appear to be any doubt about Reality Monitoring's ability to discriminate between truth and deception above the level of chance (Masip, Garrido & Herrero, 2004; Vrij, 2008), although the jury is still out on the use of cognitive words as a deception cue. An assessment of the true value of the cue is difficult to make and different researchers have defined cognitive operations differently in their studies. Vrij et al. (2008) conclude that cognitive operations can successfully discriminate between truth and deception, but their study incorporates a wider definition[20] of cognitive operations than that put forward by Johnson & Raye (1981).

For the purpose of this study, the definition of Cognitive Verbs is based on Johnson & Raye's original description which deals with idiosyncratic inferences by the authors about themselves and others e.g. *I hadn't **thought** about it till now* (Johnson & Raye, 1981). The

[20] Vrij et al.'s (2008) study included any "thoughts or reasoning" and "cognitive suppositions of sensory experiences" in their definition of cognitive operations.

cue is further limited to the use of verbs, which simplifies identification and makes it easier to tag manually.

In addition to being a potential indicator of imagined memory, Cognitive Verbs are also useful as an indicator of *alternative* information. If deceivers are unable to provide truthful information, which compromises their position, they cooperate by volunteering subjective information, which is difficult to confirm. Thus, deceivers appear helpful by explaining what they thought or how things seemed to them, which also serves to justify their behaviour e.g. ***I thought*** *the sight of my pistol would stop these guys … The guy* ***seemed*** *like he* ***knew*** *what he was doing*.

On the basis that Cognitive Verbs are indicative of memory originating from imagination and serves as a means of providing alternative subjective information, this study hypothesises that their use is positively correlated with deception.

Hypothesis 7 - The use of Cognitive Verbs is positively correlated with deception. Deceivers provide more subjective information than truth tellers, and use more words identifying thought processes which reflect the internal source of their false memories.

a) Deceptive Statements will contain a higher rate of Cognitive Verbs than Truthful Statements.
b) In Deceptive Statements, Deceptive Episodes will contain a higher rate of Cognitive Verbs than Truthful Episodes.

A Cognitive Verb is defined as a single verb which refers to a cognitive process e.g. *recall, remember, think, seem* etc.

2.4.7. Combined Cue Set

Finally, in addition to individual cues, the predictive power of linguistic markers combined in cue sets is also considered.

DePaulo et al. (2003) suggest that combining cues could potentially increase their effectiveness. Automated text-based deception detection systems have long used large sets of collective cues to identify deception. Zhou et al. (2004c) originally used 24 cues in building their automated classification model to identify deception in email communication. However,

they found that accuracy improved when they pared the cues down to only the 14 most important, achieving accuracy rates of 67% using an artificial neural network system[21].
In their investigation into high-stake deception using military personnel witness statements, Fuller, Biros & Wilson (2009) experimented with the Zhou/Burgoon cue set, as well as three other sets which incorporated linguistic markers drawn from different deception theories such as Buller & Burgoon's (1996) Interpersonal Deception Theory, Information Manipulation Theory, Reality Monitoring and Criteria Based Content Analysis. They achieved their highest accuracy result of 74% using 12 cues, also with a neural network classification system.

In a later study, Fuller, Biros & Delen (2008) achieved a slight accuracy increase to 76% with another combination of eight cues[22] using a classification algorithm system. It is interesting to note that in their earlier study[23], Fuller, Biros & Wilson (2009) concluded that 15 variables had not been important in any of their four cue set studies, including average sentence length, passive verbs and exclusive terms, the same cues which proved successful in their later study.

Such studies are limited by the use of cues that can be objectively identified and analysed independent of context. The studies are promising to the extent that they use cues such as imagery (words that provide a clear mental picture) and verb quantity, which have not previously been explored in deception detection. However, it appears from the above that the selection of linguistic cues is dependent on the type of classification tool that is used to analyse them. Zhou et al. (2004c) point out that cues identified as important using a statistical approach might not be suitable for studies using automated analysis requiring pre-training or vice versa, as there are substantial differences between the linear models involved in discriminant analysis and the non-linear models in neural networks.

Hypothesis 8 - The presence of combined cues (MoDs set) is more strongly indicative of deception than individual cues.

[21] An artificial neural network is a computational programme designed to replicate biological processing systems. It consists of a multi-layer network of units which processes information by taking information from a top input layer, subjecting it to analysis based on pre-programmed weighted decisions, and combining the results into a single value passed on to the output layer.
[22] The cue set consisted of bilogarithmic type-token ratio, imagery, average sentence length, passive verbs, First Person Singular Pronouns, First Person Plural Pronouns, exclusive terms, and lexical diversity.
[23] Fuller et al. (2008) is a later study to that reported in Fuller et al. 2009.

The MoDs set consists of any number of features defined as a Vague Pronoun Reference, Verb String, Negation and Cognitive Verbs, analysed collectively.

a) Deceptive Statements will contain a higher rate of MoDs than Truthful Statements.
b) In Deceptive Statements, Deceptive Episodes will contain a higher rate of MoDs than Truthful Episodes.

2.5. *Automatic vs. Manual Classification of Cues*

Over the past decade, there has been increasing use of automatic detection technology in the study of deception in written text, particularly to analyse text-based online messages. Using data mining techniques based on psychosocial dictionaries (e.g. DICTION and LIWC) inputted with preclassified vocabularies, this technology is able to label and count words and analyse the overall tone of thousands of email messages and blogs, making it attractive to intelligence and national security agencies.

However, there are challenges associated with this system. These preclassified vocabularies are highly sample specific, and satisfactory results needed to create reliable baselines depend on training the software to semantically analyse the texts relevant to its particular context (Larcker & Zakolyukina, 2010). Furthermore, automated word identification is highly objective as the dictionaries cannot analyse context. They do not distinguish between words spelled in the same way but having different meanings, or whose meanings change because of their context or grouping with other words. Therefore, meta data, where meaning that depends on the semantic network in which words are located, is lost is the analysis.

Another analytical methodology involves manually hand counting the presence of particular words previously identified by analysts. While this is more labour intensive than using automated classification, it enables analysts to identify linguistic dimensions and word constructs relevant to the study and determine whether words in their contexts are labelled correctly. A significant advantage of this approach over automatic classification is that subjectively identifying and tagging cues results in more powerful discrimination between truth and deception (DePaulo et al. 2003).

2.6. *The Data*

The research material in this study consisted of 40 written witness statements containing narratives voluntarily produced by individuals involved in serious crime (such as abduction, sexual assault, arson, burglary, child abuse, harassment and homicide) and provided to law-enforcement agents.

As this study required that the individuals making the report personally write the statements, the statements used were sourced from the United States. In the United Kingdom, it is standard practice that police officers write statements together with witnesses. This results in contamination of statements with the linguistic style of the interviewing police officers as they may rephrase the information given to them. Police intervention also contaminates the statement content, with requests for clarification as well as additional information that witnesses may not consider important enough to include. Witness statements are therefore a combination of witness and police input rather than witnesses' own production. In the US Statements used in this study, although police involvement in their production is kept to a minimum, 'police-speak' is noticeable in some of them, probably influenced by television programmes.

Sociolinguistic information regarding the authors is minimal. However, in the context of this study, this is not considered problematic. While it is accepted that people can behave linguistically differently with respect to individual variables of age, gender, ethnic group and class, this analysis seeks to identify valid linguistic generalisations regarding texts (in the American English written witness statement genre) that have different communication purposes -- to lie or tell the truth.

Halliday (1973) views language as having a clear communicative construct in a situational context -- the authors' goals at the time of communication influence linguistic choice. Swales (1990) uses such communicative purpose to define genre, arguing that discourse communities share common standards of communication, to the point that texts with specific communication goals are similarly schematically structured and unfold in a particular way. Swales also argues that there are two types of communicative purpose -- the overt intention which is characteristic of the genre, and the covert intention, which exists in the genre but may not be typical of it[24]. The author's goal and the context in which the communication is

[24] Swales (1990) uses media broadcasts as an example, with the overt intention of the genre typically being to keep the public informed, while the covert intention may be manipulating the information so as to produce a particular slant.

delivered exert a strong influence on the construction of the communication, and it is differences in the linguistic construction of deceptive and truthful witness statements that this study seeks to identify.

While this study does not have a sociolinguistic approach, consideration must be given to factors such as gender and age of the authors which could affect results, particularly with regards to number of words, First Person Singular Pronouns, Negation, and Cognitive Verbs. As with deception studies, gender study findings on language differences are contradictory. Some report that females are wordier[25] (in writing -- Mulac & Lundell, 1994; Bell, McCarthy & McNamara, 2006; in speaking -- Poole, 1979; Mulac & Lundell, 1986, Mulac, Weimann, Widenmann & Gibson, 1988), while others report that males use more words (in speaking – Dovidio, Brown, Heltman, Ellyson & Keating, 1988; Mulac, Seibold & Farris, 2000[26]). At least one study reports that males use more Negation (Mulac, Seibold & Farris, 2000) while others report that females do (Mulac, Lundell & Bradac, 1986; Schler, Koppel, Argomon & Pennebaker, 2005; Newman, Groom, Handelmann & Pennebaker, 2008).

Studies are generally consistent in reporting that females use more cognitive verbs -- as hedges (Lakoff, 1973; Mulac & Lundell, 1994; Poole, 1979) and as indicators of psychological processes (Newman et al. 2008[27]) -- and more First Person Singular Pronouns (Mehl & Pennebaker, 2003; Argomon, Koppel, Fine & Shimon, 2003; Newman et al. 2008); although Bell, McCarthy & McNamara (2006) find the opposite, and Mulac & Lundell (1994) and Mulac, Studley & Blau (1990) report that males make more 'I' references. Age also plays a role in language. Research into the influence of age on linguistic style in blogs finds that teenagers use more pronouns and Negation than their counterparts in their 20s and 30s, but are less verbose than them (Schler et al. 2005).

It must be borne in mind that gender-related differences are gender tendencies, not sex-related; not all men and women are masculine and feminine respectively (Cheng, Chandramouli & Subbalakshmi, 2011). Furthermore, similar linguistic differences can arise from multiple variables; for example, with age, the language of males and females becomes increasingly associated with 'male' language, while pronoun use of males in their teens is comparable with that of older (30s+) females (Schler et al. 2005). Such sociolinguistic

[25] Using mean sentence length as a measurement.
[26] Men used more words overall but women used longer sentences.
[27] Newman et al. suggest that hedging is an indicator of psychological processing and politeness rather than uncertainty.

factors are not expected to significantly impact this study given the author mix of gender, age, and social status, and that language variation on an individual basis are small (Newman et al. 2008). Context plays a significant part in determining which linguistic strategies males and females may adopt and so which features will be more apparent (Bell, McCarthy & McNamara, 2006); it is therefore expected that such linguistic strategies will be equally affected by the authors' intentions whether lie or tell the truth.

Thus, this study takes a broad generalist approach in examining how deception affects the textual behaviour of American English-speaking witness statement writers, irrespective of linguistic variation as a result of sociolinguistic factors. In short, the intention is to let the data decide which linguistic differences between truthful and deceptive statements are the most meaningful.

The 40 witness statements are divided into Groups 1 and 2, which were collected several years apart. Group 1 consists of 15 test Statements to be analysed *post hoc*, where the truth or falsity of the statements are known, and from which cues distinguishing the Truthful from Deceptive Statements are to be extracted. Group 2 consists of 25 Statements to be analysed *a priori* in a double blind study using cues extracted from Group 1 as predictors of truthfulness or deception.

Group 1 consists of 10 Deceptive Statements (numbered 1-10) and 5 Truthful Statements (numbered 11-15). The uneven numbers were due to difficulties in obtaining Statements at the first stage of the study which were known to be completely truthful. Ensuring that these Statements are indeed completely truthful was important as truthful language provides the baseline against which deceptive cues are identified. The truthfulness of statements were established through law-enforcement investigation, the evidence of other witnesses, or the authors' own admissions of guilt with supporting evidence; the deceptiveness of Statements were established through law-enforcement investigations, the evidence of other witnesses, or by court decisions on the basis of witness and/or forensic evidence.

The Statements range in length from 75 words to 884 words. The Statements' authors are US native-English speakers from diverse sociolinguistic backgrounds, ranging in age from late teens to mid-50s. They narrate events which they experienced either as an onlooker or were actively involved in the event. All individuals voluntarily wrote their own Statements between a few hours and a few days of the events occurring in response to requests to 'write what happened'.

Statement no.	Sociolinguistic Information
1	White male, 20s
2	White female, 36 yrs old
3	White male, 40 yrs old
4	White female, 17 yrs old
5	Female, age unknown, nurse
6	White male, 53 yrs old, taxi driver
7	White male, 37 yrs old, lawyer
8	Male, age unknown, security guard
9	White female, 25 yrs old
10	White male, 47 yrs old, linguistics professor
11	White male, 28 yrs old
12	White female, 34 yrs old
13	Black male, 19 yrs old
14	Black male, 20s
15	Black male, 23 yrs old

The Group 2 Statements comprising the double blind study consist of 25 Statements (numbered 16 to 40) provided under the same conditions and written by US native-English speakers, ranging in length from 111 words to 3,495 words. No information was provided regarding the authors other than their gender (12 males and 13 females). Background information regarding the texts were sent in individual emails directly to one of the study supervisors; these emails remained unopened until all analysis conducted on the Statements were completed and the study written up to the unblinding stage, at which time the emails were forwarded for unblinding.

Most of the Statements were collected as scanned copies of the original written witness statements, which were then transcribed into electronic format. Where the handwriting rendered transcription difficult, the transcribed Statements were emailed to the law enforcement agency who supplied them to verify that they accurately reflected what was written in the original Statement.

2.7. *Ethical Consideration*

A number of social and ethical issues were carefully considered in the collection of these Statements given the sensitivity of the information they contain. The Statements were provided by USA based law enforcement sources. To protect the privacy of the Statements' authors, it was agreed that access to the Statements would be strictly controlled and everything possible has been done to maintain confidentiality.

To protect the identities of the authors and their families, the Statements have been anonymised, with all dates and geographic and personal names altered so as to be unrecognisable, particularly when excerpts are used as examples in the thesis. The anonymised Statements are only available to the research supervisors and thesis examiners and are not bound together with the main thesis. The original scanned electronic documents are retained on a CD disk and no copies electronic exist outside of that disk. Any hard copies are of the anonymised versions, and these are stored under secure conditions together with the CD. Confidentiality and anonymity conditions make it inappropriate to verify the information contained in the Statements with their authors, therefore this has not been done. In three Statements belonging to the Known Group (1), information regarding the cases is available on the internet, and some verification has been undertaken in this manner.

2.8. *Episode Analysis*

In addition to examining linguistic cues in Truthful and Deceptive Statements, the placement and behaviour of cues at the sub-statement *episode* level and cue progression through the different episodes contained within individual Statements were also investigated.

This is the first study to conduct deception analysis of this kind and it will change the way monologue narratives are analysed in future. This analysis of statement episodes is much more informative than whole statement analysis as it allows greater insight into the way deception cues are introduced and how they are used throughout the statements. Episode analysis allows for the sequencing of cue behaviour and identifying fluctuations in their use which provide insight into how deceivers manage their deception.

The only previous research which examined deceptive language at the sub-statement level is that of Adams & Jarvis (2006) who subdivided their statements into three portions -- the incident central to the statement, and the events that occurred before and after it -- and measured differences in cues between the partitions. They argue (based on statement analysis techniques such as SCAN) that unbalanced narratives which lack one or more of these portions are indicative of deception, citing Johnson et al.'s (1988) finding that memories of actually experienced events tend to be associated with supporting memories preceding and following the remembered event. However, DePaulo et al. (2003) contradict this, reporting that deceivers refer to events peripheral to the central event more often than truth tellers.

In any case, the weakness of this partition method is that analysts decide at what point the different partitions begin and end. Furthermore, if a statement does not contain a *central event*, then there can be no partition (Adams & Jarvis, 2006). Subdividing a narrative into episodes, on the other hand, is possible whether the statement contains a central event or not. Additionally, it is the author who creates episodes and signposts where one episode begins and another ends; it is not left up to the discretion of the analyst.

For the purpose of this study, an episode is *a discourse unit which forms part of a progression of similar units in a narrative, the boundary of each episode being defined by a marked sentence structure signalling the opening of a new unit (and the closure of the old)*. The narratives contained in the Statements consist of a progression of episodes, each episode being created by the Statements' authors through the use of linguistic mechanisms which signal the start of a new thematic bundle and, therefore, the end of the previous bundle.

Marked sentence structures are defined as those sentences which have "an initial adjunct, subordinate clause or phrase, or prepositional phrase with an adverbial function" (McEwen & Prideaux, 1997, p. 56). Existential and presentative sentences, which contain clauses beginning with phrases such as *there was* and *that was when*, are also treated as marked (McEwen & Prideaux, 1997) e.g., *That is when I called the police about everything*. The use of the adjunct *then* in a clause initial position is also treated as the start of a new episode, although it belongs to a lower order of importance. *Then* is treated in this manner as it serves to signal the temporal order of lesser events within a larger episode.

The use of marked sentence structures to identify episodic boundaries is illustrated below on a written witness statement[28] not included in the study. This statement, originally written as a single paragraph over five pages, has been edited for length.

[28] Used with the permission of Long Island Wins http://longislandwins.com/. The full statement is available at http://www.longislandwins.com/index.php/blog/post/jeffrey_conroys_written_statement_to_police_his_sketch_of_the_crime_scene_a/ (accessed 05 July 2012).

On Saturday, November 8, 2008 my friend Jose Pacheco and I went to a girl named Alyssa's house at Atlantic Point to have dinner. I got the feeling her mom did not like me so Jose and I left. I called my Dad and he picked us up at Stop N Shop which is near Ultimate Fitness Gym. We had met up with Chris Overton, a kid I just met on Saturday. My dad drove all three of us back to my house, we got something to eat, I put on my Raider basketball sweat shirt and then the three of us walked to Medford train station. Once we got to the train station, we met with a larger group of friends, about fifteen in total and we were drinking beer. I had three beers and at one point I was play wrestling with a girl named Felicia who goes to school with me. We hung out at the Medford train station for about one and a half hours and then we all decided to go to Southaven Park. We drove in two cars. I was in Jordan Dasch's S.U.V. with about ten people. I was with Jordan, Jose, Chris, Anthony Hartford, Kevin Shea, Nick Hausch and three girls, Felicia, Nicole and Michelle Cassidy. We all attend Patchogue-Medford High School. We were not at the park very long, maybe a half hour, when Anthony Hartford said, "Let's fuck up some Mexicans." The girls didn't want any part of it Michelle said "No Chill," meaning no not to do it (fuck up some Mexicans). The rest of us (all the boys) were in agreement to do it. The girls caught a ride with Jason who owns a dark blue car. We drove to Patchogue Village, knowing that's where Spanish people hang out. We parked on a side street, near Main Street and go [sic] out and walked as a group. Everyone was pretty amped up and it was clear what we were going to do. We were only walking around for about ten [LINE CUT OFF] near the train station. They were older then us and as we walked up to them Anthony Hartford and Kevin Shea who we call "Kuvan" called the two guys "Beaners" and "Mexicans." Chris and I were being quiet and I do not recall Jordan saying anything, but everyone else said shit like "Beaner" and "Fucking Mexicans." At one point Kuvan who was talking the most shit said "I got a gun, give me your fucking money." He had his right hand stuffed into his sweatshirt front pocket as if he was hiding a gun. At first Anthony Hartford and Kevin Shea were head up on them one on one, the rest of us walked up closer, knowing we were going to fight. One of the Spanish guys whistled towards a house, as if to call out to his people. One of the Spanish guys took his shirt off, removed his belt and started swinging it at us. Kuvan thought he had a nun-chuck, but I realized it was a belt. Kuvan yelled out surround them. I'm not sure where Jordan was, but the rest of us tried to surround the Spanish guy, but couldn't because he was swinging the belt trying to keep us away. The other Spanish guy was there and was also holding his belt. I had already taken out my knife. Before the guy had even took his belt off Kuvan and Anthony Hartford had already snuffed him in the face and he was leaking blood from his nose pretty bad. Jose Pacheco was also up on the guy, body to [LINE CUT OFF] guy called him a nigger. The Spanish guy broke loose from them, and that's when he took his belt off to keep us away. At one point I got hit on the head with the belt. The Spanish guy continued to swing his belt, and when we didn't back down he swung the belt at Nicky and I went towards him with my knife in my right hand extended outward. His back was to me and as I ran towards him he turned to face me. He was about four or five feet from me, I continued to run towards him and stabbed him once in either his shoulder or chest. The physical altercation ended when I stabbed the guy. I said to Nicky "Oh shit I am fucked [I] stabbed him" as I showed him the blood on my knife.

Marked structures identifying the beginning of new episodes (and therefore the closure of the previous episode) are highlighted in yellow, identifying 13 episodes introduced by adjuncts, subordinate clauses and presentative sentences as follows:

- Episode 1 - On Saturday, November 8, 2008
- Episode 2 - then (sub-episode)
- Episode 3 - Once we got to the train station
- Episode 4 - at one point
- Episode 5 - then (sub-episode)
- Episode 6 - as we walked up to them
- Episode 7 - At one point
- Episode 8 - At first
- Episode 9 - Before the guy had even took his belt off
- Episode 10 - that’s when (presentative sentence)
- Episode 11 - At one point
- Episode 12 - when we didn’t back down
- Episode 13 - as I ran towards him

The witness statements used in this study were deconstructed similarly into their constituent episodes. Truthful Statements had all their episodes labelled as *Truthful*, while Deceptive Statements had their episodes labelled either *Truthful* or *Deceptive* based on the available evidence. Any information identified as deceptive in a single episode resulted in the entire episode being labelled *Deceptive*. Where the truth or falsity of information contained in an episode was unknown or could not be confirmed, the episode was labelled *Truthful*. This resulted in a truth bias being applied to the labelling of episodes. This application is not expected to impact on identifying deception cues as they are not expected to occur only during deception (and not anywhere else). Had this study been looking for veracity cues, creating a truth-bias would have had a material effect on analysis.

There are three reasons for studying individual episodes. First, the small sample size of Statements (15 Statements for Group 1 test texts and 25 Statements for the Group 2 double blind study) can lead to problems with overfitting in statistical analysis. Overfitting occurs where a sample size is too small in relation to the number of variables (the cues) used to analyse it. This leads to over optimistic results because cues used in the analysis to predict deception reflect ambient noise instead of the underlying signals and the real relationship between cues and the Statements’ category. An easy solution to this problem would be to increase the sample size. However, given the difficulty in sourcing witness statements, this was not possible. Consequently, it was decided to treat every episode in individual statements as a separate portion in its own right and explore how cues are distributed at this level.

The second reason for studying individual episodes is to compare linguistic differences between the truthful and deceptive portions of the same Statement. In previous research, deceptive statements have been compared with other statements written by the same and/or different authors. Same-author comparison has been undertaken with CMC messaging and blogs, where the progression of deception is analysed by comparing responses by the same author (e.g. Zhou et al. 2004a). However, comparisons were made between a progression of same-author communication that were either consistently truthful or consistently deceptive, and not between same-author mixed truthful and deceptive communication. Episode analysis is a solution to the problem of treating deceptive statements as entirely deceptive, when they may be a mix of true and false information. This is particularly relevant when a statement may be largely true, with only a small part of it being deceptive.

The third reason for examining episodes is to explore the progression of deception within a Statement. While whole communication analysis may not always exhibit indicators of deception, a sequence of continuous communication bundles on the same theme by the same author may highlight changes in language indicative of deception. It also enables analysis of the information management strategy adopted by the deceiver. Deceivers do not all lie in the same way. Some lie by leaving information out, others by adding false information, and yet others by changing small details; the language of deception may be vague, reticent, verbose, negative, subjective, or a combination of two or more. Episode analysis allows the mapping of linguistic strategy in a statement as the deception unfolds.

Deception is not a single occurrence but a progression of events that happens over time (White & Burgoon, 2001). In their study into deception in email exchanges, Zhou, Burgoon & Twitchell (2003) describe how deceptive cues change over the course of the deception. Beginning with a relatively high number of cues at the starting phase of the deceptive communication, the cues increase further in the middle phase, and then end with hardly any cues at all in the final phase. Negative effect, for example, is significantly high during the first phase of the communication but then drops off in the second phase, while the use of self-references, non-significant in phase 1, rises in phase 2.

Zhou et al. are uncertain whether the change in cues occurs because the emails in their study are written on different days, or because they represent different stages of the deception. However, they also hypothesise that deceivers' language may change as they adapt to the responses of their communication partners.

Burgoon & Qin (2006) also believe that cues change over time in the course of interactive deception. In their low stakes deception study in which interviewees alternate between truthful and deceptive responses (transcribed videotape), verbal deception cues show substantial variation across time and sequence of the responses. Deceptive profiles were very different in the first half of the interview to that in the second half, with deceivers becoming longer, simpler, less immediate, and more specific.

Although written witness statements are textual monologues and do not have the interactive properties found in email messaging and interviewing, an analysis of successive episodes may reveal features of the linguistic development of deception not noticeable when analysed on a whole statement level.

This within-statement categorisation of episodes provides a good opportunity to investigate number-of-words as a linguistic cue, as it allows for comparison between Truthful and Deceptive episodes. The association between number-of-words and deception appears uncertain as some studies suggest that deception is positively correlated with shorter responses (DePaulo et al. 2003; Newman et al. 2003; Burgoon et al. 2003), while others report that deceivers provide longer responses (Anolli & Ciceri, 1997; Anolli, Balconi & Ciceri, 2002; Zhou et al. 2004b; Hancock et al. 2005; Zhou & Zhang, 2007).

Apart from the Anolli et al. group (who study face-to-face conversation), there appears to be a consensus among researchers into CMC messaging that deceivers generally provide longer responses when lying in writing in virtual conversations.[29]

This study tests the association between number-of-words and deception with the hypothesis that Deceptive Statements will contain longer clauses than Truthful Statements. How this relates to the truthful and deceptive portions of Deceptive Statements is also the subject of investigation in this study, with the hypothesis put forward that deceivers will use more words in Deceptive episodes than in Truthful ones.

[29] Burgoon et al. (2003) suggest that in CMC communication, time to prepare a deceptive response results in longer communication.

2.9. *Problems Associated with Analysing the Witness Statements*

A number of issues associated with the analysis of these Statements were recognised early on in this study.

2.9.1. Labelling Episodes

Labelling individual episodes as *Truthful* or *Deceptive* is more problematic than identifying entire statements. In whole-statement analysis, the text is labelled *Deceptive* based on lies that may occur anywhere in the Statement. At the episode level, establishing baseline truths is difficult as investigating agents may not be able to establish correctly the truth or falsity of all the information contained in them. This was addressed by labelling all episodes as *Truthful* where the truth or falsity of the content was unknown. Consequently, the analysis of episodes has a truth bias.

2.9.2. Temporal Extent of the Narrative

While most of the Statements contain an account of the day wherein the incident took place, several authors extend the narrative to include events of the previous day in order to set the scene, or of the day after by way of explaining how they came to report the incident. One deceptive author (a statement in the Deceptive Category) chose to include the events of five days (Monday to Friday) in his narrative, although the incident occurred only on the Thursday.

Covering such a long period can be problematic. Where the information provided in days other than the incident date is truthful, it likely to dilute the whole-statement and episode level values of the cues described. Consideration was given to editing the text in order to analyse only that portion of the narrative surrounding the events of the single day. However, the idea was abandoned as this would have meant editing other texts that include additional days in the narrative, which was likely to interfere with any information management strategy their authors might use, as well as lose indicators of cognitive and emotional arousal elsewhere in the text not immediately surrounding the incident.

2.9.3. Quoted Discourse

Consideration was also given as whether or not to exclude quoted discourse (with or without quotation marks) in the analysis. According to Caldas-Coulthard (1994), any reported speech is a form of quotation. Most of the Statements contain some form of quoted discourse; one Statement in particular (Statement 14 - belonging to the *Truthful* Category) consists largely of reported speech which contains a significant number of linguistic features likely to affect the cue count of the Statement.

Caldas-Coulthard reports that quoted discourse is provided mainly because of its significance for the individual providing the quote. However, given that it is impossible to remember verbatim what is said in a conversation, even if a record is made immediately after that conversation (Coulthard & Johnson, 2007), no great reliance can be put on the accuracy of the memory. Therefore, even though speech may be presented as someone else's words, to a large extent they only represent the ideational meaning of what was said, and not the exact words used (Fairclough, 1988, as cited in Caldas-Coulthard, 1994). It would therefore prove difficult to differentiate between a third party being quoted correctly, or whether authors were conveying their own version of what was said, particularly when the use of quotation marks is irregular. For this reason, quoted discourse in any part of the narrative is not excluded from analysis.

2.9.4. Identifying Clause Length

The choice of the primary unit of analysis is one that deserves careful thought in language analysis. Consideration was given to using sentence length as a word quantity measurement to investigate differences between Deceptive and Truthful Statements. However, there are difficulties with this as the notion of a *sentence* differs from person to person, and relying on standard conventions of sentence demarcation using full stops and capitalisation is unsatisfactory. Indeed, authors' sentence punctuation proficiency in the Statements vary, with run on sentences being common, as are long sentences linked together by *and*. This makes it difficult to determine where one sentence ends and the following begins, making accurate measurements impossible.

Clause length, rather than sentence length, solves these problems. The boundary between clauses is more easily identified than in sentences and does not require reliance on authors' knowledge of punctuation and grammatical construction. Indeed, in natural speech, clauses are more so the norm than complete sentences, and at the same time, the clause fits in with basic sentence structure, which overcomes problems when analysing reported speech in the text. Therefore, clause length is used as the primary unit of analysis.

2.10. *Classification Approach*

The identification of deception in real life by law enforcement agencies[30] has long been based on a qualitative approach, where analysts make truth-lie assessments based on their interpretation of the information. In other words, each analyst's judgement is subjective, and there is no guarantee that one judgement will be the same as another on the same material. This makes it impossible to establish an accurate error rate and create a baseline which allows the application of the same conclusions to a general population.

Some methodologies have attempted to standardise approach by providing sets of rules intended to make judgements more objective. However, problems remain with their use as there is little or no guidance as to which criteria to use, what weighting should be ascribed to them if not all the criteria are present, and how many criteria should be present in the material before deception is deemed to be identified.

However, there is a place for a qualitative approach to deception detection alongside quantitative analysis. In the early stages of analysis, a qualitative approach allows for detailed description and subjective interpretation of the data within its context, something that the latter-stage counting-and-classification of quantitative analysis misses completely. While the conclusions derived from such qualitative analysis cannot be extended to a general population, they contribute to the creation of hypotheses which can be tested using quantitative/statistical methods.

In this study, hypotheses are put forward for the qualitative analysis and predictions are made for the quantitative analysis. Hypotheses for the qualitative analysis are based on the findings of previous research into deception and verbal communication which is extended to this study into textual deception using written witness statements. This serves to not only guide the direction of the qualitative study, but also determine which features may be the most productive for quantitative testing.

In other words, in addition to the presence of a particular feature and its percentage in relation to the total number of words in the episode and the statement overall, the number of clauses in which each feature occurs and its percentage as per the total clause count of each episode and statement is also calculated. The resulting values serve as the quantitative input for the qualitative and statistical classification analysis that follows.

[30] Methodologies such as Behavior Analysis Interview (BAI), Criteria Based Content Analysis (CBCA), Polygraph, Scientific Content Analysis (SCAN), Voice Stress Analysis (VSA) etc.

The quantitative approach takes the form of statistical analysis with which to test the hypotheses. This identifies whether linguistic markers being analysed truly reflect the behaviour of deceptive language, or whether their presence in the Statements is merely the result of chance. This analysis statistically measures cues previously identified qualitatively in the Group 1 Statements and uses them to predict deception *a priori* in a blind study involving the Group 2 Statements. The Group 2 Statements are also analysed qualitatively, with predictions of deception made using subjective judgements of the cues, and the results of this compared with both the predictions and the actual Statement categories.

Two classification methods are used in the statistical analysis, Discriminant Function Analysis and Logistic Regression, depending on how well the underlying data meet their analytical requirements. Logistic Regression not only makes less stringent requirements on the data than Discriminant Analysis, but it is also able to predict the probability of group membership of Statements, as well as asses the contribution value of individual cues in the prediction process. All classification algorithms are computed using SPSS15 software.

Cues	Hypothesis
Amount of Words	Positively correlated with deception
First Person Singular Pronouns	Negatively correlated with deception
Third Person Pronouns	Positively correlated with deception
Vague Pronoun Reference	Positively correlated with deception
Verb Strings	Positively correlated with deception
Negation	Positively correlated with deception
Cognitive Verbs	Positively correlated with deception
Combined Cues	Positively correlated with deception

Figure 2: Summary of Cues and Hypotheses

2.11. *Conclusion*

In conclusion, an extensive review of previous research covering deception in a variety of media reveals that deception cues do not perform as consistently as research papers appear to suggest. While Vrij (2008) suggests that general trends exist for Negation, self-references, and generalising, consistent with theory as to how deceivers might behave, most findings arise out of research conducted using poor models of deception involving low stakes lying in laboratory environments. Given the lack of real world stimuli normally found in high stakes lying, this raises questions as to how valid cues identified so far really are.

This study not only addresses these criticisms, but moves textual deception analysis forward by analysing real world high stakes lying in the form of written witness statements.

Furthermore, this study is innovative in that it proposes new approaches for:

1. analysing Statements at the episode level (in addition to the Statement as a whole);
2. viewing deception in narratives as a progression of episodes;
3. mapping the linguistic strategies deceivers adopt to tell their deceptive narratives;
4. comparing truthful and deceptive language within the same narrative.

In addition, this study is unique in that it tests the effectiveness of cues and linguistic strategies identified in a test set of Statements to predict deception *a priori* in a second set of Statements in a double blind study.

CHAPTER 3

3. Data Set Description

This study takes a contextualist stance in its qualitative analysis of witness statements. It involves describing the linguistic markers identified and attempts to explain and interpret the processes ongoing which suggest why a particular statement is identified as deceptive. The content of Group 1 and 2 Statements are first assessed for the cues previously identified, and then analysed for their frequency and density on a word and clause level for each Statement and episode within that Statement. Statement nos. 1-10 are Known Deceptive Statements, and Statement nos. 11-15 are Known Truthful Statements. Tables provide a summary of the data sets for each Statement.

3.1. *Frequency and Density of Cues – Known (Group 1) Statements*

3.1.1. Word, Clause and Episodes

The Group 1 Statements consist of 15 narratives, varying in length between 75 words (Statement no. 12) and 884 words (Statement no. 6). The number of episodes within Statements vary between 1 (Statement no. 11 – the 2nd shortest statement) and 19 episodes (Statement no. 10 – the 5th longest statement). There does not appear to be any relationship between Statement length and the number of episodes contained in the narrative.

Statement No.	Words	Clauses	Average clause length	Episodes
1	598	105	5.7	8
2	217	47	5.1	10
3	255	39	6.8	12
4	194	29	7.4	5
5	252	44	6.6	8
6	884	145	6.4	10
7	248	34	7.2	5
8	212	36	5.5	4
9	614	95	7.5	13
10	519	78	7.0	19
11	83	18	4.6	1
12	75	15	5.1	2
13	220	44	5.1	5
14	822	174	4.7	6
15	353	63	5.6	2

Figure 3: Known Statements - Word and Clause Measurements

The number of clauses in individual Statements range from 15 clauses (Statement no. 12 – the shortest Statement) to 174 clauses (Statement no. 14 – the 2nd longest Statement). The average clause length (number of words in a clause) for each Statement is calculated using the clause-length average of its episodes, and not the overall whole-statement average. This not only provides a more accurate picture of clause length, it also allows a view as to how it changes from episode to episode as the narrative progresses within the Statement. Average clause lengths range from 4.6 words per clause (Statement no. 11 – the 2nd shortest Statement) to 7.5 words per clause (Statement no. 9 – the 3rd longest Statement). There does not appear to be any relationship between statement length and clause length.

3.1.2. First Person Singular Pronouns

All Statements use First Person Singular Pronouns, ranging from a minimum of 7 pronouns (Statement no. 12) to a maximum of 88 (Statement no. 6). Statement nos. 8 and 14 contain the lowest pronoun densities, with 3.3% and 5.8% of total word count respectively, while Statement nos. 1 and 2) have the highest pronoun count with 11% and 12.4% respectively.

Statement No.	Words	First Person Singular Pronouns	Word %	I	Word %	Me	Word %	My	Word %
1	598	66	11.0	32	5.4	19	3.2	15	2.5
2	217	27	12.4	13	6.0	4	1.8	10	4.6
3	255	23	9.0	11	4.3	3	1.2	8	3.1
4	194	14	7.2	10	5.2	1	0.5	3	1.5
5	252	20	7.9	14	5.6	1	0.4	5	2.0
6	884	88	10.0	39	4.4	24	2.7	25	2.7
7	248	21	8.5	14	5.6	2	0.8	5	2.0
8	212	7	3.3	3	0.9	2	1.4	1	0.5
9	614	55	9.0	26	4.2	6	0.9	23	3.7
10	519	40	7.7	30	5.8	0	0	10	1.9
11	83	9	10.8	7	8.4	1	1.2	1	1.2
12	75	7	9.3	5	6.7	0	0	2	2.7
13	220	19	8.6	11	5.0	6	2.7	2	0.9
14	822	48	5.8	41	5.0	4	0.5	3	0.4
15	353	25	7.1	21	5.9	2	0.6	2	0.6

Figure 4: Known Statements - First Person Singular Pronouns (Word) Measurements

All Statements use the pronoun ***I***, ranging from a minimum of 3 (Statement no. 8) to a maximum of 41 (Statement no. 14). Statement nos. 8 and 9 have the lowest ***I*** density, with 0.9% and 4.2% of total word count, while Statement nos. 11 and 12 have the highest with 8.4% and 6.7% respectively.

Thirteen Statements (87%) use the pronoun *Me*, ranging from a minimum of 1 (Statement nos. 4, 5 and 11) to a maximum of 24 (Statement no. 6); two Statements (nos. 10 and 12) do not use *Me* at all. Statement no. 5 has the lowest density with 0.4%, followed by Statement nos. 4 and 14 with 0.5%, while Statement nos. 1 and 13 have the highest with 3.2% and 2.7% of total word count.

All the Statements use *My*, ranging from a minimum of 1 (Statement nos. 8 and 11) to a maximum of 23 (Statement no. 9). Statement nos. 8 and 14 have the lowest densities, with 0.5%, and 0.4%, while Statement nos. 2 and 9 have the highest with 4.6% and 3.7% of total word count respectively.

Statement No.	Clauses	First Person Singular Pronoun	Clause %	I	Clause %	Me	Clause %	My	Clause %
1	105	62	59.0	32	30.5	18	17.1	15	14.3
2	47	25	53.2	13	27.7	4	8.5	9	19.1
3	40	15	38.5	11	28.2	3	7.7	6	15.4
4	29	13	44.8	10	34.5	1	3.4	3	10.3
5	43	17	39.5	14	32.6	1	2.3	4	9.3
6	145	78	53.8	39	26.9	24	16.6	22	15.2
7	34	19	55.9	14	41.2	2	5.9	5	14.7
8	36	6	16.7	3	8.3	2	5.6	1	8.3
9	95	48	50.5	26	27.4	6	6.3	23	24.2
10	78	36	46.2	30	38.5	0	0	10	12.8
11	18	8	44.4	7	38.9	1	5.6	1	5.6
12	15	7	46.7	5	33.3	0	0	2	13.3
13	44	18	40.9	11	25.0	6	13.6	2	4.5
14	174	48	27.6	41	23.6	4	2.3	3	1.7
15	63	25	39.7	21	33.3	2	3.2	2	3.2

Figure 5: Known Statements - First Person Singular Pronouns (Clause) Measurements

With regards to clause measurements, Statement nos. 8 and 14 have the lowest percentage of clauses containing First Person Singular Pronouns, with 16.7% and 27.6% respectively, while Statement nos. 1 and 7 contain the highest with 59% and 55.9%.

The lowest use of *I* clauses are found in Statement nos. 8 and 14, with 8.3% and 23.6%, while Statement nos. 7 and 11 contain the highest, with 41.2% and 38.9% respectively. As for *Me* clauses, Statement nos. 5 and 14 contain the lowest percentage, with 2.3% each, while Statement nos. 1 and 6 contain the highest, with 17.1% and 16.6%. Finally, *My* clauses are used the least in Statement nos. 14 and 15, with 1.7% and 3.2% respectively, while Statement nos. 2 and 9 contain the highest percentage, with 19.1% and 24.2%.

3.1.3. Third Person Pronouns

Apart from Statement no. 7, all Statements use Third Person Pronouns, from a minimum of 3 (Statement no. 11) to a maximum of 102 (Statement no. 14). Statement nos. 5 and 10 contain the lowest percentage of Third Person Pronouns, with 0.8% and 1.5% of total word count. The highest percentage of pronouns is found in Statement nos. 14 and 2, with 12.4% and 10.6% of word count respectively.

Statement No.	Words	Third Person Pronouns	Word %	Clauses	Third Person Pronouns	Clause %
1	598	23	3.8	105	22	21.0
2	217	24	10.6	47	23	48.9
3	255	11	4.3	40	10	25.6
4	194	10	5.2	29	10	34.5
5	252	2	0.8	43	2	4.7
6	884	45	5.1	145	41	28.3
7	248	0	0	34	0	0
8	212	22	10.4	36	18	50.0
9	614	12	2.0	95	12	12.6
10	519	8	1.5	78	8	10.3
11	83	3	3.6	18	3	16.7
12	75	6	8.0	15	5	33.3
13	220	18	8.2	44	16	36.4
14	822	102	12.4	174	92	52.9
15	353	12	3.4	63	12	19.0

Figure 6: Known Statements - Third Person Pronouns Measurements

Statement nos. 5 and 10 have the lowest usage of Third Person Pronoun clauses, with 4.7% and 10.3% of total clause count; Statement nos. 8 and 14 have the highest with 50% and 52.9% of clauses.

3.1.4. Vague Pronoun References

Vague Pronoun References are found in only ten Statements, and usage is generally low in comparison to the other linguistic cues measured.

Seven Statements use Vague Pronoun References at less than 1% of total word count, with Statement no. 9 being the lowest at 0.2%. Only three Statements have usage equivalent to 1% of total word count or higher, with Statement no. 3 having the highest at 2%.

The lowest percentage of clauses containing Vague Pronoun References are found in Statement nos. 9 and 14, with 1.1% of total clause count each, while the highest use is in Statement nos. 1 and 3, with 9.5% and 12.8% respectively.

Statement No.	Words	Vague Pronoun References	Word %	Clauses	Vague Pronoun References	Clause %
1	598	10	1.7	105	10	9.5
2	217	1	0.5	47	1	2.1
3	255	5	2.0	40	5	12.8
4	194	2	1.0	29	2	6.9
5	252	1	0.4	43	1	2.3
6	884	4	0.5	145	4	2.8
7	248	1	0.4	34	1	2.9
8	212	0	0	36	0	0
9	614	1	0.2	95	1	1.1
10	519	0	0	78	0	0
11	83	0	0	18	0	0
12	75	0	0	15	0	0
13	220	0	0	44	0	0
14	822	3	0.4	174	2	1.1
15	353	1	0.3	63	1	1.6

Figure 7: Known Statements - Vague Pronoun Reference Measurements

3.1.5. Verb Strings

By its nature, a Verb String is composed of more than one word. However, for the purpose of this measurement, a Verb String is counted as a single occurrence of the cue for the purposes of word count, irrespective of the number of words in the string. For example, in the clause *and trying to grab arms*, the three-word verb string *trying to grab* counts as a single cue. Verb Strings do not include auxiliary verbs as the aim is to capture ambiguity of action rather than subtleties of time and mood. In those cases where the auxiliary verb *have* is used to mean *need* (e.g. *I had to* [needed to] *unlock the door*), it is treated as a Verb String.

Thirteen Statements used Verb Strings in their narratives, from a minimum of 2 (Statement no. 3) to a maximum of 12 (Statement no. 6), with 2 Statements (nos. 11 and 12) using none at all. Statement nos. 10 and 14 have the lowest use, with 0.4% and 0.7% of total word count, while Statement nos. 4 and 13 have the highest percentage of Verb Strings, with 2.1% and 2.7% respectively.

As regards clause count, Statement nos. 10 and 14 have the lowest percentage, with 2.6% and 3.4% respectively, while Statement nos. 4 and 13 have the highest with 13.8% and 13.6%.

Statement No.	Words	Verb Strings	Word %	Clauses	Verb Strings	Clause %
1	598	10	1.7	105	10	9.5
2	217	4	1.8	47	4	8.5
3	255	2	0.8	40	2	5.1
4	194	4	2.1	29	4	13.8
5	252	5	2.0	43	5	11.6
6	884	12	1.4	145	12	8.3
7	248	3	1.2	34	3	8.6
8	212	3	1.4	36	3	8.3
9	614	6	1.0	95	6	6.3
10	519	2	0.4	78	2	2.6
11	83	0	0	18	0	0
12	75	0	0	15	0	0
13	220	6	2.7	44	6	13.6
14	822	6	0.7	174	6	3.4
15	353	4	1.1	63	4	6.3

Figure 8: Known Statements - Verb String Measurements

3.1.6. Negation

Eleven Statements use Negation, from a minimum of 1 (Statement no. 4) to a maximum of 21 (Statement no. 14), while 4 Statements (nos. 3, 11, 12 and 13) do not use any. Four Statements have very low usage of less than 1% of total word count, with Statement no. 4 having the lowest percentage at 0.5%. Statement nos. 8 and 14 have the highest percentage of Negation at 2.4% and 2.9% of total word count respectively.

Statement No.	Words	Negation	Word %	Clauses	Negation	Clause %
1	598	11	1.8	105	11	10.5
2	217	2	0.9	47	2	4.3
3	255	0	0	40	0	0
4	194	1	0.5	29	1	3.4
5	252	3	1.2	43	3	7.0
6	884	10	1.1	145	10	6.9
7	248	3	1.2	34	3	8.8
8	212	6	2.8	36	6	16.7
9	614	8	1.3	95	8	8.4
10	519	3	0.6	78	3	3.8
11	83	0	0	18	0	0
12	75	0	0	15	0	0
13	220	0	0	44	0	0
14	822	24	2.9	174	19	10.9
15	353	3	0.8	63	3	4.8

Figure 9: Known Statements - Negation Measurements

Statement nos. 4 and 10 have the lowest percentage of Negation clauses, with 3.4% and 3.8%, while Statement nos. 8 and 14 have the highest at 16.7% and 10.9% respectively.

3.1.7. Cognitive Verbs

Fourteen Statements contain Cognitive Verbs in their narratives, from a minimum of 1 (Statement nos. 2, 3, 4, 8, 11 and 12) to a maximum of 14 (Statement no. 6). One Statement (no. 13) does not contain any Cognitive Verbs at all. Eight Statements use Cognitive Verbs at less than 1% of total word count, the lowest being Statement no. 3, with 0.4%. Statement nos. 6 and 9 have the highest percentage with 1.6% and 2.1% respectively.

Statement No.	Words	Cognitive Verbs	Word %	Clauses	Cognitive verbs	Clause %
1	598	9	1.5	105	9	8.6
2	217	1	0.5	47	1	2.1
3	255	1	0.4	40	1	2.6
4	194	1	0.5	29	1	3.4
5	252	3	1.2	43	3	7.0
6	884	14	1.6	145	14	9.7
7	248	3	1.2	34	3	8.8
8	212	1	0.5	36	1	2.8
9	614	13	2.1	95	13	13.7
10	519	4	0.8	78	4	5.1
11	83	1	0.5	18	1	5.6
12	75	1	1.3	15	1	6.7
13	220	0	0	44	0	0
14	822	4	0.5	174	4	2.3
15	353	3	0.8	63	3	4.8

Figure 10: Known Statements - Cognitive Verb Measurements

As for clauses containing Cognitive Verbs, Statement nos. 2 and 14 have the lowest usage of between 2.1% - 5.6% of clauses, while Statement nos. 6 and 9 have the highest at 9.7% and 13.7% respectively.

3.1.8. Combined Cues Set (MoDs)

The density of combined cues -- Vague Pronoun References, Verb Strings, Negation, and Cognitive Verbs, collectively referred to as MoDs (Markers of Deception) -- in the Statements is also measured. First Person Singular Pronouns were not included in the cue set as the pronouns are hypothesised to be indicators of truthfulness while MoDs are collectively associated with deception. Although Third Person Pronouns are also hypothesised to be positively correlated with deception, Newman et al. (2003) report that deceivers use them less than truth tellers. Given the uncertainty over their association, it was decided to exclude them from the cue set.

For word count, linguistic features which combine to create a single cue are counted according to the number of cues present. For example, the sentence *I do not remember seeing headlights*, which contains a Negation (*not*), a Cognitive Verb (*remember*), and a Verb String (*remember seeing*), is tagged three times. On the other hand, for clause count, clauses containing cues are tagged only once irrespective of the number of different cues in them. For example, the sentence *I do not remember seeing headlights* is tagged only once although it contains three cues.

All Statements contain at least one feature from the MoDs set, ranging from a minimum of 1 (Statement nos. 11 and 12) to a maximum of 40 (Statement nos. 1 and 6). Statement nos. 11 and 12 have the lowest use, with 1.2% and 1.3%; Statement nos. 1 and 5 have the highest, with 6.7% and 7%.

Statement No.	Words	MoDs	Word %	Clauses	MoDs	Clause %
1	598	40	6.7	105	33	31.4
2	217	8	3.7	47	8	17.0
3	255	8	3.1	40	6	17.9
4	194	8	4.1	29	7	24.1
5	252	12	7.0	43	12	27.9
6	884	40	4.5	145	34	23.4
7	248	10	4.0	34	8	23.5
8	212	10	4.7	36	9	25
9	614	28	4.6	95	21	22.1
10	519	9	1.7	78	8	10.3
11	83	1	1.2	18	1	5.6
12	75	1	1.3	15	1	6.7
13	220	6	2.7	44	6	13.6
14	822	34	4.1	174	31	17.8
15	353	11	3.1	63	9	14.3

Figure 11: Known Statements - Combined Cue Set Measurements (MoDs)

In clause count, Statement nos. 11 and 12 have the lowest percentage of clauses that contain at least one feature from the MoDs cue set, with 5.6% and 6.7% respectively, while Statement nos. 1 and 5 contain the highest number of clauses at 31.4% and 27.9%.

3.2. ***Frequency and Density of Cues – Blinded (Group 2) Statements***

Group 2 consists of 25 Statements whose categories (*Truthful* or *Deceptive*) are unknown to the analyst and supervisors. Cues and linguistic strategies identified in the previous Group are used to predict deception in these Statements in a double blind study, the first time this has been undertaken in deception research.

3.2.1. Word, Clause and Episodes

The shortest Statement (no. 21) has 111 words in 19 clauses, while the longest (Statement no. 34) has 3,495 words in 631 clauses. Average clause length bears no relationship to statement length, the shortest average clause length being 4.7 words per clause (Statement no. 22), and the longest 7.5 words per clause (Statement no. 25).

Similarly, episode numbers bear little relationship to statement lengths, with the lowest number of episodes in a Statement being only 2 (Statement no. 39), and the highest being 97 episodes (Statement no. 34).

Statement No.	Words	Clauses	Average clause length	Episodes
16	162	29	6.1	6
17	420	78	6.1	16
18	387	73	5.2	9
19	884	172	6.0	17
20	881	175	5.1	14
21	111	19	6.2	6
22	199	43	4.7	7
23	1130	200	6.0	28
24	486	72	7.0	11
25	1147	163	7.5	14
26	485	120	4.8	15
29	208	41	5.2	6
28	478	94	5.2	12
29	1570	306	5.5	37
30	511	104	4.8	7
31	619	127	5.5	15
32	566	109	5.5	15
33	283	53	5.5	10
34	3495	631	6.0	97
35	427	81	6.2	10
36	138	30	4.8	4
37	492	87	5.8	11
38	201	38	6.3	3
39	363	75	4.9	2
40	175	31	5.8	7

Figure 12: Blinded Statements - Word and Clause Count

3.2.2. First Person Singular Pronouns

All Statements use First Person Singular Pronouns, from a minimum of 5 (Statement no. 40) to a maximum of 288 pronouns (Statement no. 34). Statement no. 40 has the lowest pronoun use, with 2.9%, while Statement nos. 26 and 30 have the highest, with 14% and 13.7% respectively.

All Statements use the pronoun *I*, from a minimum of 3 (Statement nos. 21 and 40) to a maximum of 162 (Statement no. 34). Statement nos. 24 and 25 have the lowest ***I*** density, with 1.4%, while Statement nos. 26 and 30 have the highest, with 7.2% and 7.6% respectively.

Statement No.	Words	First Person Singular Pronouns	Words %	I	Words %	Me	Words %	My	Words %
16	162	7	4.3	6	3.7	1	0.6	0	0
17	420	45	10.7	22	5.2	11	2.6	12	2.9
18	387	12	3.1	9	2.3	0	0	3	0.8
19	884	58	6.6	38	4.3	13	1.5	5	0.6
20	881	101	11.5	46	5.2	33	3.7	22	2.5
21	111	6	5.4	3	2.7	1	0.9	2	1.8
22	199	15	7.5	6	3	5	2.5	4	2.0
23	1130	120	10.6	76	6.7	26	2.3	16	1.4
24	486	15	3.1	7	1.4	6	1.2	2	0.4
25	1147	98	3.1	37	1.4	17	1.2	42	0.4
26	485	68	14.0	35	7.2	21	4.3	12	2.5
29	208	25	12.0	17	8.2	6	2.9	2	1.0
28	478	26	5.4	21	4.4	3	0.6	2	0.4
29	1570	174	11.1	97	6.2	45	2.9	32	2.0
30	511	70	13.7	39	7.6	16	3.1	15	2.9
31	619	69	11.1	42	6.8	18	2.9	9	1.5
32	566	57	10.1	25	4.4	20	3.5	11	1.9
33	283	28	9.9	12	4.2	11	3.9	5	1.8
34	3495	288	8.2	162	4.6	58	1.7	65	1.9
35	427	19	4.4	16	3.7	0	0	3	0.7
36	138	7	5.1	7	5.1	0	0	0	0
37	492	30	6.1	22	4.5	7	1.4	1	0.2
38	201	15	7.5	10	5.0	5	2.5	0	0
39	363	30	8.3	27	7.4	1	0.3	1	0.3
40	175	5	2.9	3	1.7	0	0	2	1.1

Figure 13: Blinded Statements - First Person Singular Pronoun (Word) Measurements

Twenty-one Statements use the pronoun *Me*, from a minimum of 1 (Statement nos. 16, 21 and 39) to a maximum of 58 (Statement no. 34); four Statements (nos. 18, 35, 36 and 40) do not use any *Me* at all. Statement nos. 28 and 39 have the lowest pronoun density with 0.6% and 0.3% respectively, while Statement nos. 26 and 33 have the highest, with 4.3% and 3.9% of total word count.

Twenty-two Statement use the pronoun *My*, from a minimum of 1 (Statement nos. 37 and 39) to a maximum of 42 (Statement no. 25); 3 Statements (nos. 16, 36 and 38) do not use it at all. Statement nos. 37 and 39 have the lowest density, with 0.2% and 0.3% respectively, while Statement nos. 17 and 30 have the highest, with 2.9% each of total word count.

Statement No.	Clauses	First Person Singular Pronouns	Clause %	I	Clause %	Me	Clause %	My	Clause %
16	29	7	24.1	6	20.7	1	3.4	0	0
17	78	40	51.3	22	28.2	11	14.1	12	15.4
18	73	10	13.7	9	12.3	0	0	3	4.1
19	172	54	31.4	38	22.1	13	7.6	5	2.9
20	175	94	53.7	46	26.3	33	18.9	22	12.6
21	19	4	21.1	3	15.8	1	5.3	2	10.5
22	43	14	32.6	6	14.0	5	11.6	4	9.3
23	200	113	56.5	76	38.0	26	13.0	16	8.0
24	72	15	20.8	7	9.7	6	8.3	2	2.8
25	163	88	54.0	37	22.7	17	10.4	42	25.8
26	120	62	51.7	35	29.2	21	17.5	12	10.0
29	41	23	56.1	17	41.5	6	14.6	2	4.9
28	94	25	26.6	21	22.3	3	3.2	2	2.1
29	306	159	52.0	97	31.7	45	14.7	32	10.5
30	104	66	63.5	39	37.5	16	15.4	15	14.4
31	127	62	48.8	42	33.1	18	14.2	9	6.3
32	109	55	50.5	25	22.9	20	18.3	11	10.1
33	53	28	52.8	12	22.6	11	20.8	5	9.4
34	631	271	42.9	162	25.7	58	9.2	65	9.2
35	81	16	19.8	16	19.8	0	0	3	3.7
36	30	7	23.3	7	23.3	0	0	0	0
37	87	28	32.2	22	25.3	7	8.0	1	1.1
38	38	15	39.5	10	26.3	5	13.2	0	0
39	75	30	40.0	27	36.0	1	1.3	1	1.3
40	31	4	12.9	3	9.7	0	0	2	6.5

Figure 14: Blinded Statements - First Person Singular Pronoun (Clause) Measurements

With clause counts, Statement nos. 40 and 18 have the lowest percentage of clauses containing First Person Singular Pronouns, with 12.9% and 13.7%, while Statement nos. 23 and 30 have the highest, at 56.5% and 63.5% respectively.

Statement nos. 24 and 40 have the lowest use of *I* clauses, with 9.7% each, while Statement nos. 23 and 29 have the highest, with 38% and 41.5%. As for *Me* clauses, Statement nos. 28 and 39 have the lowest use, with 1.3% and 3.2%; Statement nos. 20 and 33 have the highest, with 18.9% and 20.8%. Finally, Statement nos. 37 and 39 contain the lowest percentage of *My* clauses, with 1.1% and 1.3% respectively, while Statement nos. 17 and 25 use the most, with 15.4% and 25.8% of total clause count.

3.2.3. Third Person Pronouns

All the Statements use Third Person Pronouns, from a minimum of 2 (Statement no. 16) to a maximum of 279 (Statement no. 34). Statement nos. 16 and 49 have the lowest use, with 1.2% and 1.7% of total word count; Statement nos. 35 and 36 have the highest, with 11.9% and 16.7% respectively.

Statement No.	Words	Third Person Pronouns	Word %	Clauses	Third Person Pronouns	Clause %
16	162	2	1.2	29	2	6.9
17	420	25	6.0	78	23	29.5
18	387	23	5.9	73	21	28.8
19	884	99	11.2	172	84	48.8
20	881	93	10.6	175	88	50.3
21	111	5	4.5	19	4	21.1
22	199	8	4.0	43	8	18.6
23	1130	76	6.7	200	71	35.5
24	486	44	9.1	72	36	50.0
25	1147	82	9.1	163	75	46.0
26	485	30	6.2	120	29	24.2
29	208	9	4.3	41	9	22.0
28	478	33	6.9	94	30	31.0
29	1570	172	11.0	306	147	48.0
30	511	37	7.2	104	36	34.6
31	619	48	7.8	127	46	36.2
32	566	37	6.5	109	34	31.2
33	283	31	11.0	53	23	43.4
34	3495	279	8.0	631	265	42.0
35	427	51	11.9	81	47	58.0
36	138	23	16.7	30	21	70.0
37	492	36	7.3	87	36	41.4
38	201	18	9.0	38	17	44.7
39	363	33	9.1	75	31	41.3
40	175	3	1.7	31	3	9.7

Figure 15: Blinded Statements - Third Person Pronoun Measurements

Statement nos. 16 and 40 have the lowest percentage of Third Person Pronoun clauses, with 6.9% and 9.7% respectively, while Statement nos. 35 and 36 have the highest, with 58% and 70% of clauses containing the pronouns.

3.2.4. Vague Pronoun References

Nineteen Statements use Vague Pronoun References, from a minimum of 1 (Statement nos. 18, 21, 24, 30, 32 and 38) to a maximum of 20 (Statement no. 34); 6 Statements (nos. 22, 31, 33, 35, 36 and 37) did not use any at all. Fourteen Statements make low use of Vague Pronoun References, with less than 1% of total word count; Statement nos. 24, 30 and 32 have the lowest use, with 0.2% each. The highest use of the feature is found in Statement no. 40, at 1.7%.

Statement No.	Words	Vague Pronoun References	Word %	Clauses	Vague Pronoun References	Clause %
16	162	2	1.2	29	2	6.9
17	420	2	0.5	78	2	2.6
18	387	1	0.3	73	1	1.4
19	884	5	0.6	172	5	2.9
20	881	5	0.6	175	5	2.9
21	111	1	0.9	19	1	5.3
22	199	0	0	43	0	0
23	1130	3	0.3	200	3	1.5
24	486	1	0.2	72	1	1.4
25	1147	5	0.4	163	5	3.1
26	485	6	1.2	120	5	4.2
29	208	2	1.0	41	2	4.9
28	478	2	0.4	94	2	2.1
29	1570	6	0.4	306	6	2.0
30	511	1	0.2	104	1	1.0
31	619	0	0	127	0	0
32	566	1	0.2	109	1	0.9
33	283	0	0	53	0	0
34	3495	20	0.6	631	20	3.2
35	427	0	0	81	0	0
36	138	0	0	30	0	0
37	492	0	0	87	0	0
38	201	1	0.5	38	1	2.6
39	363	4	1.1	75	4	5.3
40	175	3	1.7	31	3	9.7

Figure 16: Blinded Statements - Vague Pronoun Reference Measurements

As regards clause use, Statement nos. 30 and 32 contain the lowest concentration of the feature, comprising 0.9% and 1% of clauses, while Statement nos. 16 and 40 have the highest, with 6.9% and 9.7% of clauses respectively.

3.2.5. Verb Strings

Twenty-four Statements use Verb Strings in their narratives, from a minimum of 1 (Statement nos. 16, 21, 22 and 38) to a maximum of 46 (Statement no. 34); 1 Statement (no. 40) does not use the feature at all. Seven Statements use Verb Strings at less than 1% of total word count, the lowest being Statement nos. 17, 22 and 38, with 0.5% each, while Statement nos. 20 and 31 have the highest percentage of Verb Strings, with 4.2% and 3.7% respectively.

Statement No.	Words	Verb Strings	Word %	Clauses	Verb Strings	Clause %
16	162	1	0.6	29	1	3.4
17	420	2	0.5	78	2	2.6
18	387	5	1.3	73	5	6.8
19	884	15	1.7	172	15	8.7
20	881	37	4.2	175	37	8.7
21	111	1	0.9	19	1	5.3
22	199	1	0.5	43	1	2.3
23	1130	12	1.1	200	12	6.0
24	486	4	0.8	72	4	5.6
25	1147	18	1.6	163	18	11.0
26	485	12	2.5	120	12	10.0
29	208	6	2.9	41	6	14.6
28	478	9	1.9	94	9	9.6
29	1570	42	2.7	306	42	13.7
30	511	5	1.0	104	5	4.8
31	619	23	3.7	127	23	18.1
32	566	10	1.8	109	10	9.2
33	283	5	1.8	53	5	9.4
34	3495	46	1.3	631	46	7.3
35	427	7	1.6	81	7	8.6
36	138	4	2.9	30	4	13.3
37	492	3	0.6	87	3	3.4
38	201	1	0.5	38	1	2.6
39	363	4	1.1	75	4	5.3
40	175	0	0	31	0	0

Figure 17: Blinded Statements - Verb String Measurements

As regards clause count, Statement no. 22 (2.3%) has the lowest concentrations of Verb String clauses, followed by Statement nos. 17 and 38, with 2.6% each; Statement nos. 29 and 31 have the highest percentage of Verb Strings, with 14.6% and 18.1% respectively.

3.2.6. Negation

All 25 Statements use Negation, from a minimum of 1 (Statement nos. 16, 21 and 33) to a maximum of 28 (Statement no. 20). Six Statements have very low usage of less than 1% of total word count, Statement no. 33 being the lowest at 0.4%, followed by Statement nos. 17 and 18, with 0.5% each. The highest use of Negation is found in Statement nos. 26 and 30, with 3.3% and 4.3% of total word count respectively.

The lowest use of Negation clauses is found in Statement nos. 33 and 17, with 1.9% and 2.6% respectively; Statement nos. 26 and 30 have the highest rates at 11.7% and 17.3%.

Statement No.	Words	Negation	Word %	Clauses	Negation	Clause %
16	162	1	0.6	29	1	3.4
17	420	2	0.5	78	2	2.6
18	387	2	0.5	73	2	2.7
19	884	14	1.6	172	14	8.1
20	881	28	3.2	175	28	8.1
21	111	1	0.9	19	1	5.3
22	199	4	2.0	43	4	9.3
23	1130	16	1.4	200	16	8.0
24	486	5	1.0	72	5	6.9
25	1147	11	1.0	163	11	6.7
26	485	16	3.3	120	14	11.7
29	208	3	1.4	41	3	7.3
28	478	6	1.3	94	6	6.4
29	1570	19	1.2	306	19	6.2
30	511	22	4.3	104	18	17.3
31	619	14	2.3	127	6	11.0
32	566	6	1.1	109	6	5.5
33	283	1	0.4	53	1	1.9
34	3495	54	1.5	631	54	8.6
35	427	4	0.9	81	4	4.9
36	138	2	1.4	30	2	6.7
37	492	8	1.6	87	8	9.2
38	201	4	2.0	38	4	10.5
39	363	9	2.5	75	8	10.7
40	175	2	1.1	31	2	6.5

Figure 18: Blinded Statements - Negation Measurements

3.2.7. Cognitive Verbs

Twenty-two Statements use Cognitive Verbs in their narratives, from a minimum of 1 (Statement nos. 20, 21, 33 and 36) to a maximum of 63 (Statement no. 34). Three Statements (nos. 22, 38 and 40) do not use any Cognitive Verbs at all. Twelve Statements make very low use of the feature at less than 1% of total word count, the lowest being Statement nos. 20 and 25, with 0.1% and 0.3% respectively; Statement nos. 16, 21 and 34 have the highest use, with 1.8% each.

As for Cognitive Verb clauses, Statement nos. 33 and 17 have the lowest concentration, with 1.9% and 2.6% respectively. The highest concentration is found in Statement nos. 16 and 21, with 10.3% and 10.5%.

Statement No.	Words	Cognitive Verbs	Word %	Clauses	Cognitive Verbs	Clause %
16	162	3	1.8	29	3	10.3
17	420	2	0.5	78	2	2.6
18	387	5	1.3	73	5	6.8
19	884	14	1.6	172	14	8.1
20	881	1	0.1	175	1	8.1
21	111	2	1.8	19	2	10.5
22	199	0	0	43	0	0
23	1130	10	0.9	200	10	5.0
24	486	2	0.4	72	2	2.8
25	1147	4	0.3	163	4	2.5
26	485	8	1.6	120	8	6.7
29	208	3	1.4	41	3	7.3
28	478	6	1.3	94	6	6.4
29	1570	12	0.8	306	12	3.9
30	511	6	1.2	104	6	5.8
31	619	7	1.1	127	7	5.5
32	566	4	0.7	109	4	3.7
33	283	1	0.4	53	1	1.9
34	3495	63	1.8	631	63	10.0
35	427	4	0.9	81	4	4.9
36	138	1	0.7	30	1	3.3
37	492	5	1.0	87	5	5.7
38	201	0	0	38	0	0
39	363	3	0.8	75	3	4.0
40	175	0	0	31	0	0

Figure 19: Blinded Statements - Cognitive Verb Measurements

3.2.8. Combined Cue Set (MoDs)

The term MoDs (Markers of Deception) is used to refer collectively to features included in the Combined Cue set (Vague Pronoun References, Verb Strings, Negation, and Cognitive Verbs). All Statements contain at least one feature from the MoDs set, from a minimum of 4 (Statement no. 21) to a maximum of 183 (Statement no. 34). At the lowest end, Statement nos. 22, 24 and 33 each contain MoDs accounting for 2.5% of total word count; Statement nos. 20 and 26 have the highest use, with 8% and 8.7% respectively.

As for clause count, Statement nos. 22 and 33 have the lowest percentage of MoDs clauses, with 11.6% and 13.2%; Statement nos. 20 and 31 contain the highest, with 34.3% and 31.5% respectively.

Statement No.	Words	MoDs	Word %	Clauses	MoDs	Clause %
16	162	7	4.3	29	5	17.2
17	420	22	5.2	78	18	23.1
18	387	13	3.4	73	10	13.7
19	884	48	5.4	172	40	23.3
20	881	71	8.1	175	60	34.3
21	111	5	4.5	19	3	15.8
22	199	5	2.5	43	5	11.6
23	1130	41	3.6	200	36	18.0
24	486	12	2.5	72	11	15.3
25	1147	38	3.3	163	37	22.7
26	485	42	8.7	120	33	27.5
29	208	14	6.7	41	11	26.8
28	478	23	4.8	94	20	21.3
29	1570	79	5.0	306	70	23.0
30	511	34	6.7	104	24	23.1
31	619	44	7.1	127	40	31.5
32	566	21	3.7	109	21	19.3
33	283	7	2.5	53	7	13.2
34	3495	183	5.2	631	148	23.5
35	427	15	3.5	81	12	14.8
36	138	7	5.1	30	6	20.0
37	492	16	3.3	87	16	18.4
38	201	6	3.0	38	6	15.8
39	363	20	5.5	75	12	16.0
40	175	5	2.9	31	5	16.1

Figure 20: Blinded Statements - Combined Cues Measurements (MoDs)

3.3. *Conclusion*

In summary, data regarding 8 selected features (word count, First Person Singular Pronouns, Third Person Pronouns, Vague Pronoun References, Verb Strings, Negation, Cognitive Verbs, and the MoDs Combined Cue set) were extracted from the 15 Known (Group 1) and 25 Blind Study (Group 2) Statements.

In addition to frequency, the density of occurrence is calculated according to total number of words as well as total number of clauses in the Statement. In analysing frequency, the occurrence of a single cue is counted as one, even if the feature consists of more than one word (such as with Verb Strings). In analysing density, the same applies with regards to total word count. With respect to clause count density, any number of the same feature in a single clause (as with *My*, Third Person Pronouns, and MoDs) is counted as one. This data provides the basis for qualitative and statistical analyses in the forthcoming chapters.

CHAPTER 4

4. Descriptive and Qualitative Analysis of Known (Group 1) Statements

4.1. *Method*

Bearing in mind the results of previous deception studies, the analysis presented here seeks to establish, first, whether deception cues identified in verbal and CMC interactive communications also apply to written narrative statements; and second, whether cues in combination provide stronger differentiation between the categories than single cues. Third, the descriptive and qualitative analysis aims to describe the way the features are used during deception and truth telling, focusing on small (rather than statistically significant) differences between the Truthful and Deceptive Statements. Finally, the analysis explores the interaction between cues with the aim of identifying linguistic strategies adopted by deceivers in order to determine how they chose to structure their deception, in addition to their choice of words.

This section deals with data from the Known (Group 1) Statements, where the truth or deceptiveness of the Statements are already known, and so are analysed *post hoc*. Deceptive cues and linguistic strategies identified from this set will be used to predict deception *a priori* in the blinded (Group 2) Statements.

Following on from the data described in Chapter 3, linguistic features identified in Known Truthful (Statement nos. 1-10) and Deceptive (Statement nos. 11-15) Statements were compared to explore their behaviour, and reconcile their presence with the known identification of individual statements and episodes as *Truthful* or *Deceptive*.

In addition to comparing the entire Statement, cues found in individual episodes of Deceptive Statements (Statement nos. 1-10) were further analysed according to whether the episode was categorised *Truthful* or *Deceptive*. This aims to explore how cue behaviour might change within the same Statement, depending on whether the author is lying or telling the truth. One Statement (no. 8) from the Deceptive category could not be partitioned into Truthful and Deceptive episodes as the narrative was identified as entirely *Deceptive*. Therefore, this Statement is excluded from episode analysis.

It is hypothesised that the density of cues such as Third Person Pronouns (Knapp, Hart & Dennis, 1974; Knapp & Comadena, 1979; Hancock et al. 2005; DePaulo et al. 2003), Vague Pronoun References and Verb Strings (as markers of vagueness and ambiguity - - Knapp, Hart & Dennis, 1974), Negation (Knapp & Comadena, 1979; Newman et al. 2003; Zhou et al. 2004c; Adams & Jarvis, 2006; Toma & Hancock, 2010), and Cognitive Verbs (Sporer, 1997; Johnson & Raye, 1981; Hartwig et al. 2005; Vrij et al. 2008) are positively correlated with deception. Consequently, it is expected that cue distribution within Statements in the Deceptive category will also be concentrated within Deceptive episodes.

4.2. *Results*

The differences in cues in between Truthful and Deceptive Statements, as well as Truthful and Deceptive episodes belonging to individual Deceptive Statements, are described and visually represented using column graphs. In whole-statement analysis, Deceptive Statements (nos. 1-10) are coloured red, while Truthful Statements (nos. 11-15) are blue. In episode analysis (only of Deceptive Statements), Deceptive episodes are coloured red and Truthful episodes are blue.

4.2.1. Hypothesis 1

Hypothesis 1a is supported, with deceivers being more verbose (7 words/clause) than their Truthful counterparts (5 words/clause) (Figure 21). Six Deceptive Statements (nos. 3-5, 7, 9 and 10) have longer clauses at ≥ 7 words/clause, than four Truthful Statements (nos. 11-14), with ≤ 5 words/clause.

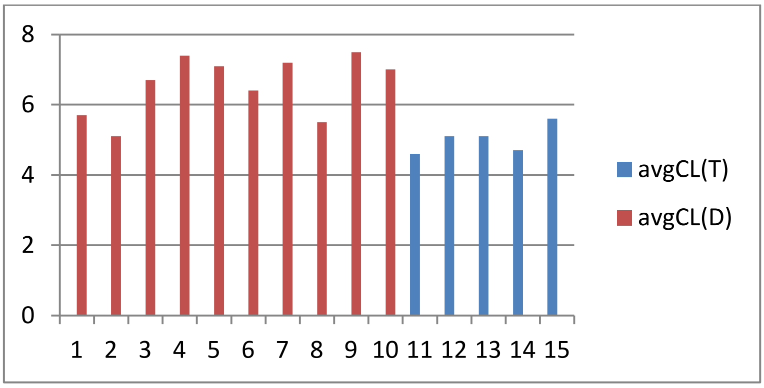


Figure 21: Known Statements - Average Clause Length (Statements)

However, at the episode level (Hypothesis 1b), the association between longer clauses and deception is not supported.

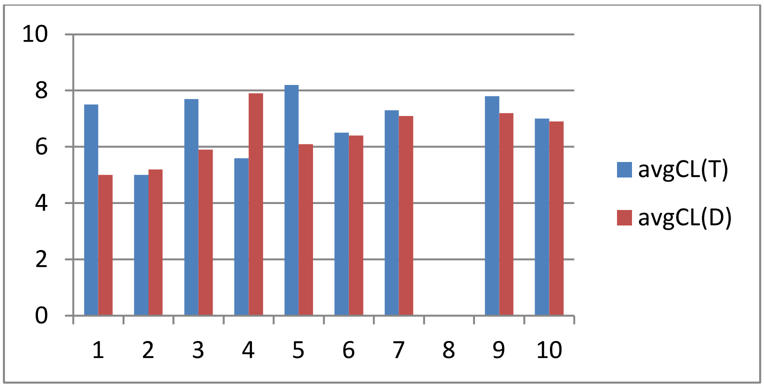


Figure 22: Known Statements - Average Clause Length (Episodes)

In 7 Deceptive Statements (nos. 1, 3, 5-7, 9 and 10), clauses are slightly longer in Truthful episodes and not in Deceptive episodes as hypothesised (Figure 22). It is unclear whether differences arise because deceivers elaborate more when telling the truth, or say less when lying. If the average clause length of 5 words/clause is taken as typical of truth tellers (as compared to 7 words/clause for Deceptive Statements), then truth tellers do not appear to be verbose generally. It may be that deceivers feel on safer ground when telling the truth, and therefore say slightly more to compensate for the reduction in information when they are lying. Anolli et al. (2003) describe a *Cuttlefish Effect* where deceivers hide their lies within a mass of truthful (albeit irrelevant) information, while Vrij (2008), DePaulo et al. (2003), and Hartwig et al. (2006) describe deceivers as being less forthcoming when lying. Clause length results suggest that the reality may be a combination of the two.

However, liars appear to devote more of their statement to lying than truth telling. In all graphs except for one (Deceptive Statement no. 10), deception involves at least 60% of the total number of clauses used in the narratives (Figure 23).

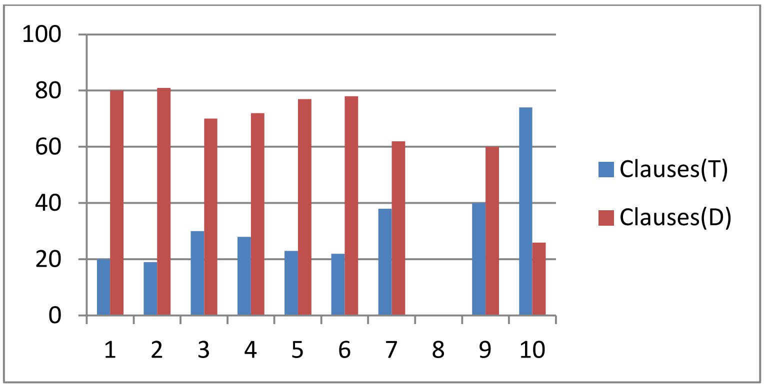


Figure 23: Known Statements - Clause Count (Episodes)

Only Statement no. 10 devotes more clauses to truth telling. However, this Statement differs from other Deceptive Statements in that it contains a five-day narrative, as its author chooses to include the events of four other days, in addition to the day of the incident central to the Statement. Consequently, the majority of clauses are devoted to truthful information, albeit irrelevant to the event.

Statement No.	Clauses	Truthful	Clause %	Deceptive	Clause%
1	105	21	20	84	80
2	47	9	19	38	81
3	40	12	30	28	70
4	29	8	28	21	72
5	43	10	23	33	77
6	145	32	22	113	78
7	34	13	38	21	62
8	36	0	0	36	0
9	95	38	40	57	60
10	78	58	74	20	26

Figure 24: Known Statements Clause Count - Truthful and Deceptive Episodes

This preference, to devote more of the Statement to lying, conflicts with previous findings described earlier (Anolli et al. 2003; DePaulo et al. 2003; Hartwig et al. 2006; Vrij, 2008). If deceivers prefer to say less when lying, it appears contradictory to spend more of the statement lying. One explanation may be that deceivers feel they have to justify their lie, and so spend more time explaining themselves.

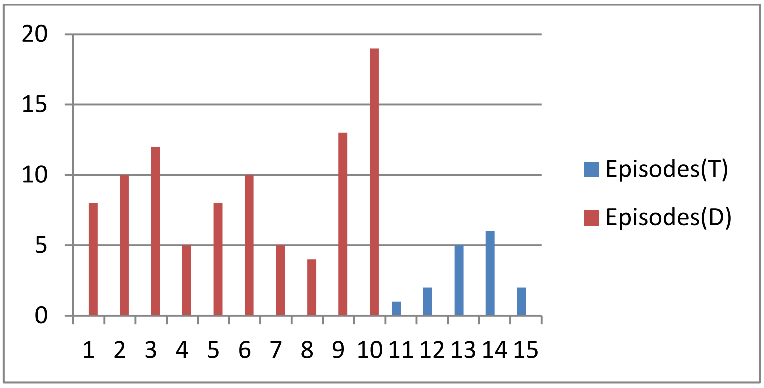


Figure 25: Known Statements - Number of Episodes

Deceivers and truth tellers also appear to structure their Statements differently, with deceivers preferring to construct their narratives using shorter episodes than truth tellers, particularly during deception. This narrative break-up can only be identified using marked sentence structures to identify episode boundaries, as the fragmentation is not reflected in the overt paragraph construction of Statements. In other words, deceivers construct smaller episodes within much larger paragraph structures.

Seven Deceptive Statements (nos. 1-3, 5, 6, 9 and 10) contain more episodes than the most fragmented Truthful Statement (no. 14) (Figure 25). Seven Deceptive Statements (nos. 1-4, 6, 7 and 9) also contain more Deceptive episodes than Truthful episodes, with one Statement (no. 8) having no Truthful episode at all (Figure 26).

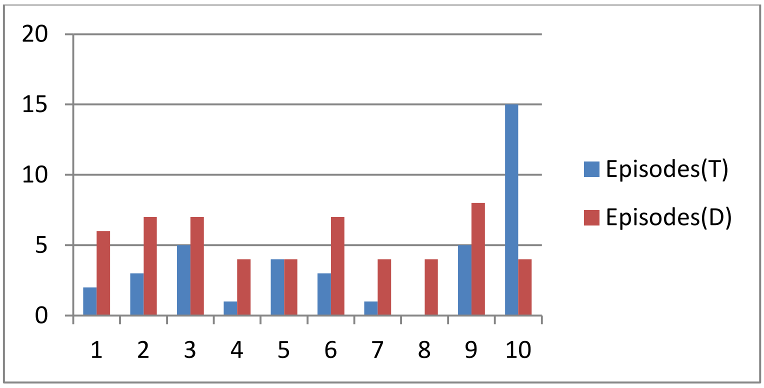


Figure 26: Known Statements - Number of Truthful and Deceptive Episodes

Statement no. 5 has an equal number of Deceptive and Truthful episodes. However, while the Statement is divided into four Truthful and four Deceptive episodes, Deceptive episodes contain 77% of the Statement's clauses. Only Statement no. 10 devotes more episodes to truth telling, again because of its extended narrative. However, when the episode structure of the one relevant day (ignoring the remaining four days included in the narrative) is examined, four out of the five episodes of the day are Deceptive.

It may be that Deceptive Statements fragment into smaller (and more) Deceptive episodes because the events and timeline are not grounded in reality. Consequently, the narratives lack cohesion and continuity, which deceivers find themselves subconsciously signalling as they tell their stories.

4.2.2. Hypothesis 2

No support is found for Hypothesis 2a. Contrary to previous findings that deceivers use less self-references than truth tellers (Knapp, Hart & Dennis, 1974; Dulaney, 1982; Burgoon et al. 1996a; Newman et al. 2003; Zhou et al. 2004c; Bond & Lee, 2005; Hancock et al. 2004; Hancock et al. 2005), no negative correlation is found between First Person Singular Pronouns and deception in the Known Statements.

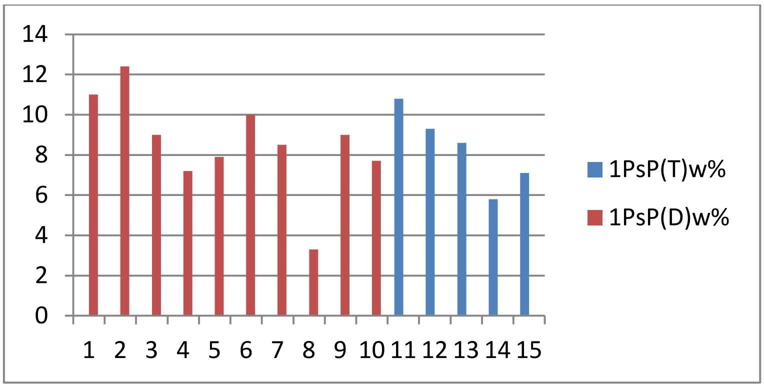


Figure 27: Known Statements - First Person Singular Pronouns (Word)

As a percentage of word count, there is little difference between deceivers' and truth tellers' use of First Person Singular Pronouns; self-references constitute 8.6% of words in Deceptive Statements, compared to 8.3% in Truthful Statements (Figure 27). However, 45.7% of clauses contain self-references in Deceptive Statements, compared to 39.9% in Truthful Statements (Figure 28).

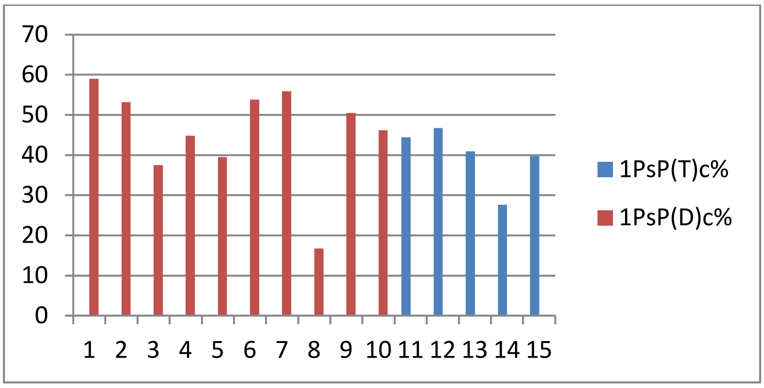


Figure 28: Known Statements - First Person Singular Pronouns (Clause)

It is interesting to note that the only Deceptive Statement with any significant reduction in First Person Singular Pronouns is Statement no. 8, which is the entirely deceptive narrative. It may be that the fact the Statement is entirely deceptive, as opposed to a partially false narrative, may have had some bearing on the deceiver's choice of linguistic strategy; however, no conclusion can be reached on the basis of a single statement

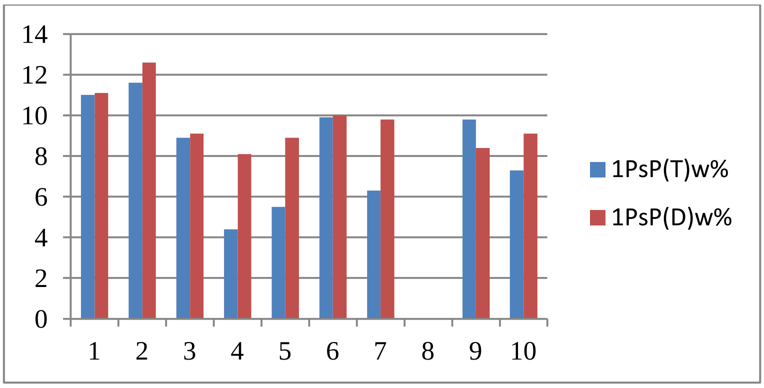


Figure 29: Known Statements - First Person Singular Pronouns in Episodes (Word)

Neither is there any support for Hypothesis 2b, that Deceptive episodes will contain a lower rate of First Person Singular Pronouns than Truthful episodes. Eight Statements (nos. 1-7 and 10) use more self-references in their Deceptive episodes than in their Truthful episodes (although the differences are marginal in Statement nos. 1, 3 and 6), with the pronouns overall constituting a slightly higher 9.7% of word count in Deceptive episodes, compared to 8.3% in Truthful episodes (Figure 29).

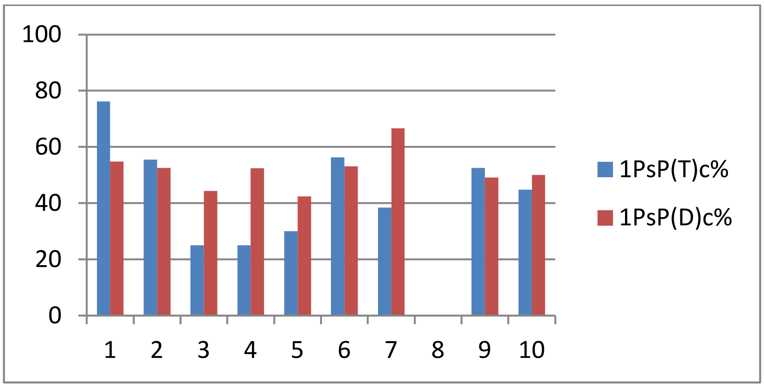


Figure 30: Known Statements - First Person Singular Pronouns in Episodes (Clause)

Overall, Deceptive episodes also contain more clauses with self-references (50.5%) compared to Truthful episodes (44.9%). However, this result is influenced by large differences in Statement nos. 3, 4 and 7; otherwise, no general trend in either direction is identified (Figure 30).

I, *Me*, and *My* were also analysed individually to explore any differences in loading between them, although no hypothesis was put forward regarding their performance. Overall, *I* constitutes 6.2% of words in Truthful Statements, compared to 4.7% in Deceptive

Statements (Figure 31). However, there is little difference in ***I*** clause use between them, with Truthful Statements containing only a marginally higher 30.8% compared to 29.5% in Deceptive Statements (Figure 32). Statement no. 8 has the lowest percentage of ***I*** use for both word and clause count of the Group 1 Statements, consistent with its very low usage of First Person Singular Pronouns.

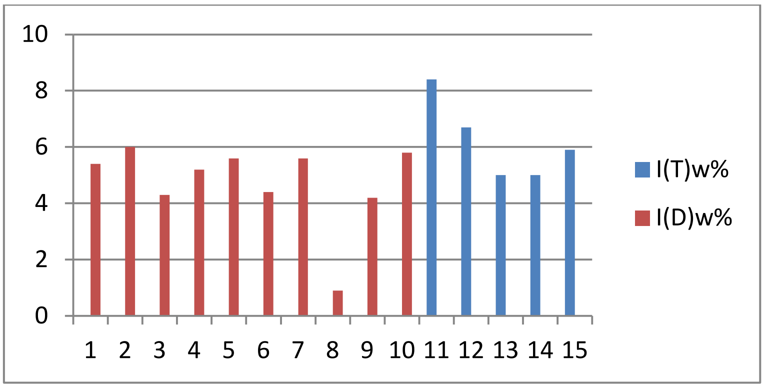


Figure 31: Known Statements - *I* Count (Word)

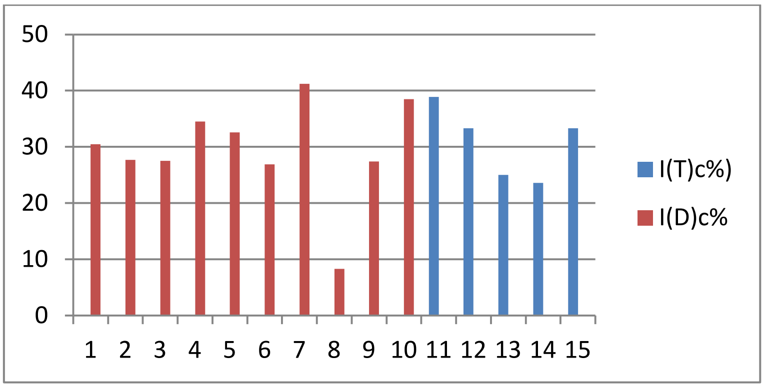


Figure 32: Known Statements - *I* Count (Clause)

No general trend emerges for the use of ***I*** in Truthful and Deceptive episodes. Overall, ***I*** constitutes 5.5% of words in Truthful episodes, compared to 5.3% in Deceptive episodes (Figure 33), while ***I*** clauses make up 34.7% of clauses in Truthful episodes, only slightly higher than 31.8% of ***I*** clauses found in Deceptive episodes (Figure 34).

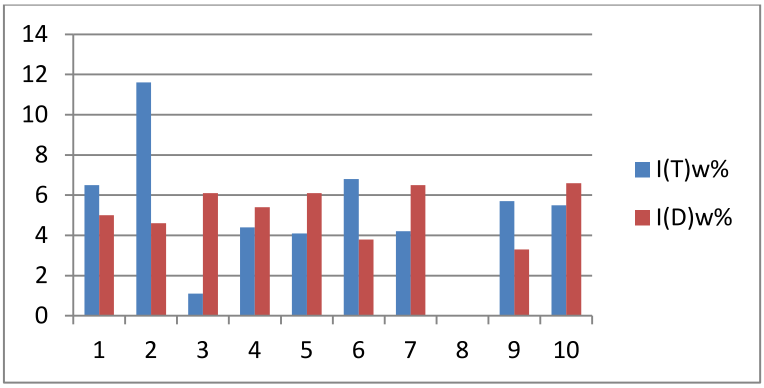


Figure 33: Known Statements - *I* Count in Episodes (Word)

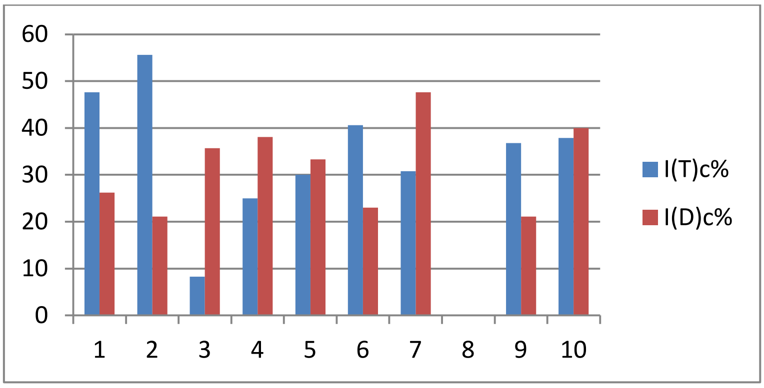


Figure 34: Known Statements - *I* Count in Episodes (Clause)

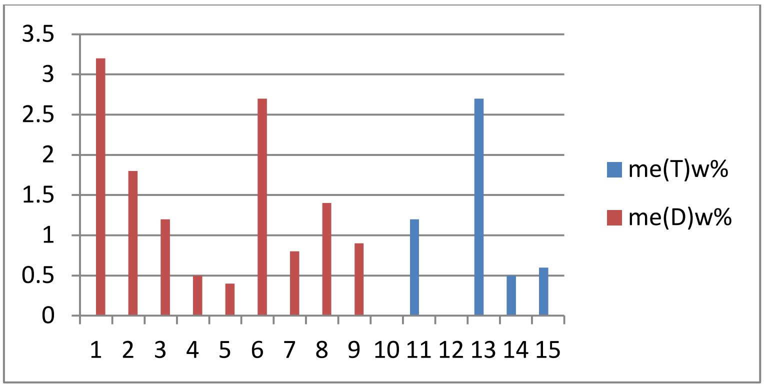


Figure 35: Known Statements - *Me* Count (Word)

As for *Me*, there is little difference between Deceptive and Truthful Statements as a percentage of word count. Overall, *Me* constitutes 1.3% of words in Deceptive Statements, compared with 1% in Truthful Statements, with very high percentages in Statement nos. 1 and 6 (compared to the rest of the Deceptive Statements) affecting measurements overall in that category, and likewise with Statement no. 13 within the Truthful narratives (Figure 35).

With clause measurements, 7.3% of clauses in Deceptive Statements contain *Me,* compared to 4.9% of clauses in Truthful Statements (Figure 36); as with word, spikes in *Me* clause use in Statement nos. 1, 6 and 13 influence results. However, even with these outliers removed, *Me* clauses in Deceptive Statements are still nearly twice that found in Truthful Statements.

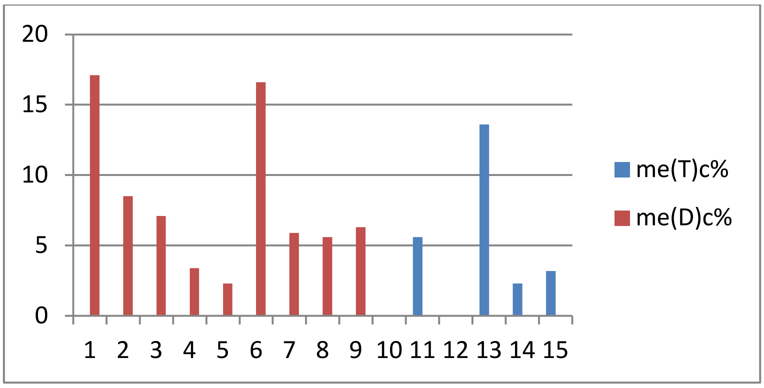


Figure 36: Known Statements - *Me* Count (Clause)

At the episode level, a trend appears for increased use of *Me* during deception. Overall, *Me* has double the density of word count in Deceptive Statements at 1.5%, compared to Truthful episodes with 0.7% (Figure 37), as well as nearly double the density of *Me* clauses in Deceptive episodes at 8.3%, compared to 4.4% in Truthful episodes (Figure 38). In 3 of the 8 Deceptive Statements (nos. 2, 4 and 5), *Me* occurs only in their Deceptive episodes, and is used more in the Deceptive episodes of Statement nos. 1, 6 and 9 than in their Truthful episodes. Statement no. 10 makes no use of *Me* at all, which is unusual, considering its length (500+ words).

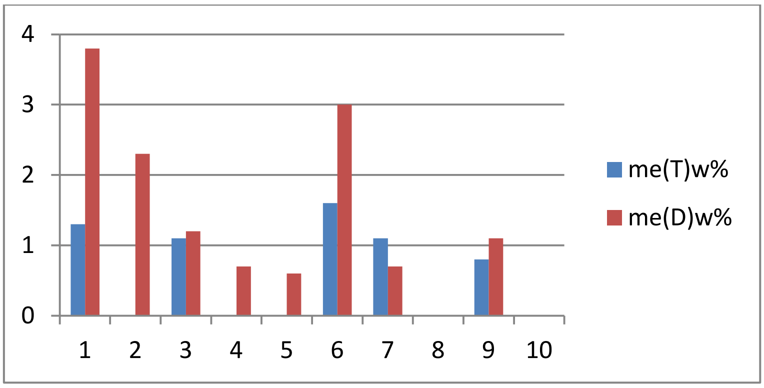


Figure 37: Known Statements - *Me* Count in Episodes (Word)

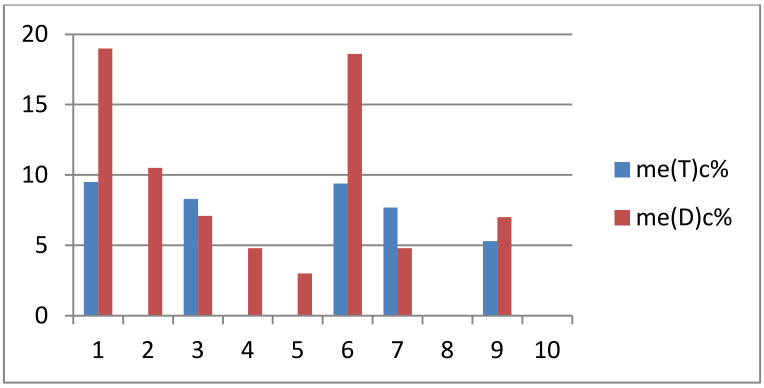


Figure 38: Known Statements - *Me* Count in Episodes (Clause)

Contrary to previous findings, that liars tend to distance themselves from their lies by reducing their use of self-references (Weiner & Mehrabian, 1968; Knapp, Hart & Dennis, 1974; Knapp & Comadena, 1979; Newman et al. 2003; Hancock et al. 2005), the results suggest that, at least in the context of written witness statements, deception does not follow that pattern.

Deceivers' personal presence in the events described, as evidenced by the level of First Person Singular Pronouns in Truthful and Deceptive Statements, do not decrease during deception; instead, self-references continue at more or less the same level throughout it. What changes is the role played by deceivers in their narratives, as defined by self-references used. From an active role as agent of the action as identified by *I*, to a more passive presence with *Me* presenting themselves as recipients of the action, deceivers may become more involved or take a backseat approach as they deem necessary. However, at all times, they are present in one form or another in the event, as in the excerpt:
***I** left to go back to work…**I** thought maybe **I** hit him…then he pushed **me** in my van and then made **me** drive, the he told **me** to stop crying. He told **me** to stop the van.* (Statement no. 1)

This move, from active agent to passive recipient, is reflected further in the analysis results for the possessive pronoun *My*. In Deceptive Statements, *My* constitutes 2.5% of words, double the 1.2% found in Truthful Statements (Figure 39). Nine Deceptive Statements (nos. 1-7, 9 and 10) contain higher use of *My* than 4 Truthful Statements (nos. 1, 3-5).

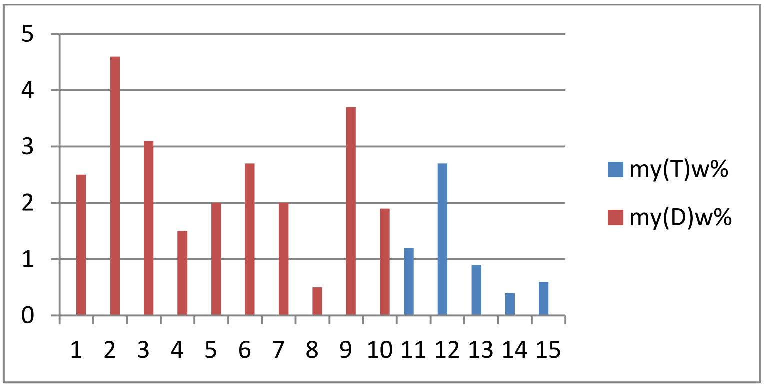


Figure 39: Known Statements - *My* Count (Word)

Furthermore, Deceptive Statements contain over double the use of *My* clauses at 14.3%, compared to Truthful Statements at 5.7%, with all 10 Deceptive Statements making more use of *My* clauses than 4 of the 5 Truthful Statements (nos. 1, 3-5) (Figure 40).

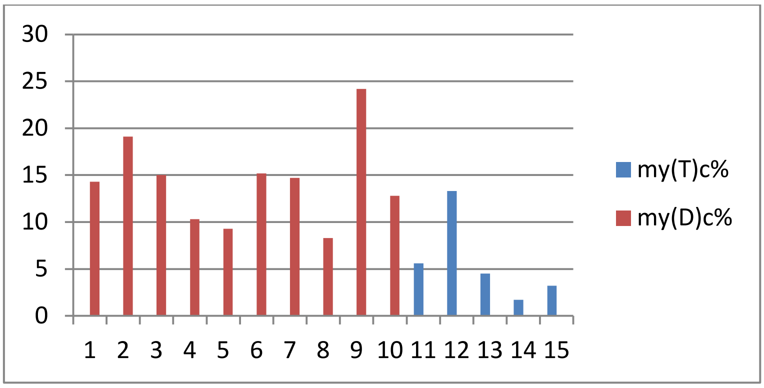


Figure 40: Known Statements - *My* Count (Clause)

At the episode level overall, *My* constitutes 2.9% of words in Deceptive episodes, marginally more than the 2.1% found in Truthful episodes. However, when looking at the distribution of the pronoun, *My* occurs only in the Deceptive episodes of 2 Statements (nos. 2 and 4), and is used more in the Deceptive episodes of 5 Statements (nos. 5 -7, 8 and 9) than in their Truthful counterpart (Figure 41).

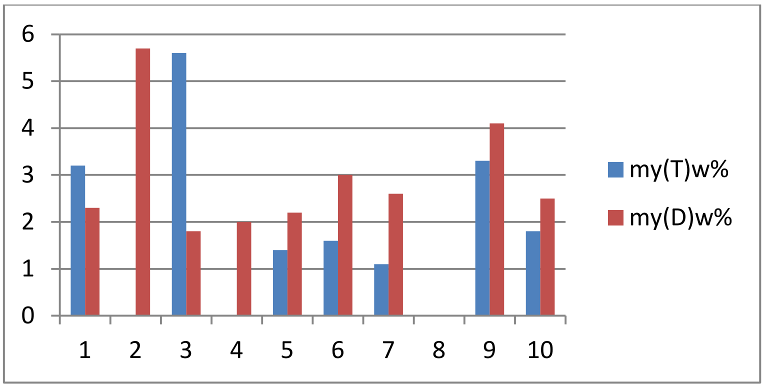


Figure 41: Known Statements - *My* Count in Episodes (Word)

Deceptive episodes make much more use of *My* clauses, with 16.3% compared to Truthful episodes with 12.1%. *My* clause distribution between Truthful and Deceptive episodes is similar to word with the exception of Statement no. 5, which is reversed, showing higher use of *My* clauses in its Truthful episodes (Figure 42). This is due to the inclusion of 2 pronouns in a single clause (4 occurrences of *My* in 3 clauses).

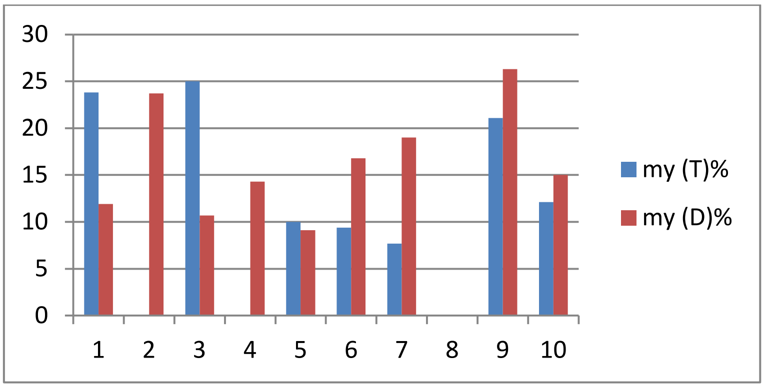


Figure 42: Known Statements - *My* Count in Episodes (Clause)

This anomaly is due to the dependent role of *My*, which qualifies nouns instead of replacing them, unlike *I* and *Me*. Whereas *I* or *Me* can only occur once in any given clause (the author, either as subject or object of the verb), *My* may appear any number of times in a single clause, as in the excerpt:

***My** wife, myself and **my** son came home today…then me, **my** wife and **my** son and our roommate Pete went upstairs.* (Statement no. 3)

Why use of *My* should increase during deception is not as easily explained as an increase in *Me*. *My* tends to focus readers' attention on the minutiae of the author's attributes and personal possessions, rather than on the author as an individual, as in the excerpt:

"*…and one came back grabbed **my** hair lifted **my** head and cut **my** forehead*…" (Statement 1)

*"He took tape out and put it on **my** hands, and then he cut **my** lips…then put tape on **my** face. He cut **my** dress…he cut **my** hair…He locked **my** keys in **my** van."* (Statement no. 2)

It may be that deceivers attempt to reinforce the credibility of their information by resorting to details about themselves or external objects, on which they stamp a personal association through the use of *My*. By repeatedly using the pronoun, deceivers may hope that their addressees perceive the provision of such details, and the deceivers' willingness to claim ownership, as a marker of truthfulness.

It is interesting to observe that, where *Me* and *My* clauses are used in a narrative, deceivers show a trend for higher use of *My* than *Me* (Figure 43). Of the 13 Known Group Statements (nos. 1-9, 11, 13-15) where *I*, *Me*, and *My* are used collectively, 7 Statements (nos. 2-5, 7-9), all belonging to the Deceptive category have higher use of *My* clauses than *Me* clauses.

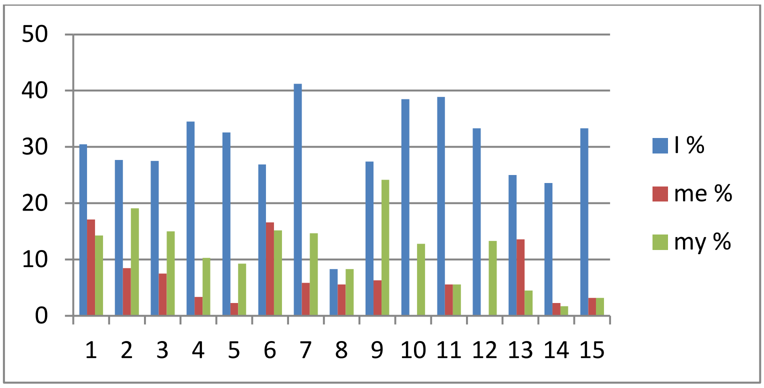


Figure 43: Known Statements - *I*, *Me* and *My* Interaction (Clause)

It may be that differences in the use of *Me* and *My* clauses are associated with deception as high use of *My* suggests that deceivers are focusing on things associated with them, rather than on themselves as individuals, even in a passive role using *Me*. The excerpt -- ***I** felt something cold. He went to hit **me** again, and something cut the palm of **my** left hand* (Statement no. 1) -- describes the different stages of distancing deceivers can achieve, as they move away from *I* (as agent of the action) to *Me* (as passive recipient of the action) to *My* (where the deceiver is completely absent as an individual, except for ownership of the hand).

4.2.3. Hypothesis 3

Hypothesis 3a is not supported. Contrary to previous findings that deceivers use more *other* person references than truth tellers (DePaulo et al. 2003; Hancock et al. 2004; Hancock et al. 2005), in this Known Group analysis, Third Person Pronouns are associated with truth telling.

Third Person Pronouns constitute 7.1% of words in Truthful Statements, a higher percentage than the 4.4% found in Deceptive Statements (Figure 44). The pronouns also constitute a higher percentage of clauses in Truthful Statements, with 31.7% compared to 23.5% in Deceptive Statements (Figure 45). Even with the exclusion of Statement no. 14, whose high use of the pronoun influences upwards the Truthful category average, overall, Truthful Statements still make higher use of Third Person Pronouns than Deceptive Statements.

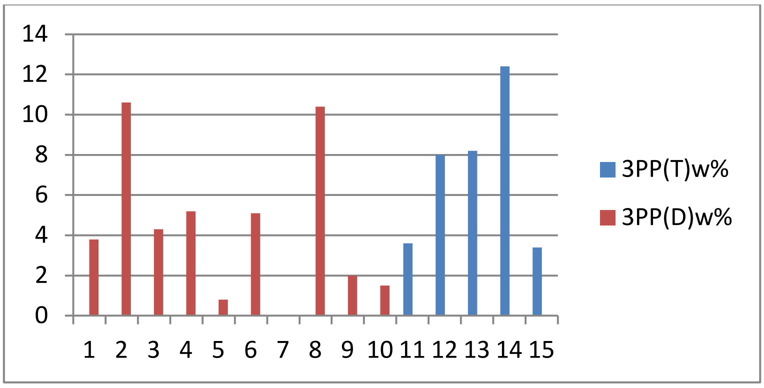


Figure 44: Known Statements - Third Person Pronouns (Word)

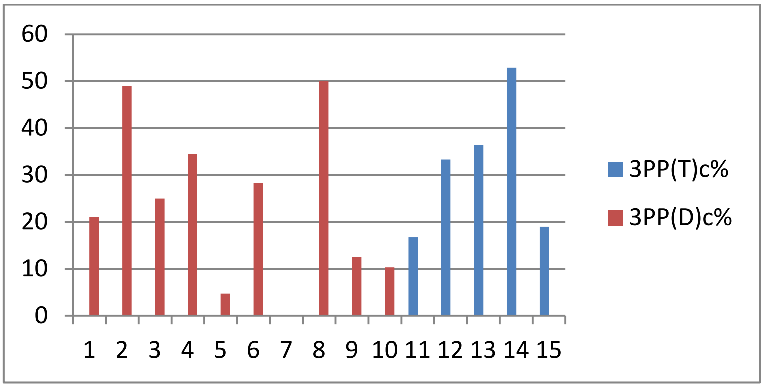


Figure 45: Known Statements - Third Person Pronouns (Clause)

This finding is consistent with Newman et al. (2003), Zhou et al. (2004c), and Bond & Lee (2005) but difficult to explain. Ickes et al. (1986) report that Machiavellian individuals are more likely to speak of themselves at the expense of others, resulting in more First Person Singular Pronouns than Third Person Pronouns, while high self-monitoring individuals are more likely to talk about others than themselves[31] (Barnes & Ickes, 1979, as cited in Ickes et al. 1986), resulting in the opposite.

No study has identified how much of an increase in the use of Third Person Pronouns, or what percentage of the pronouns as compared to First Person Pronouns is indicative of deception; or even if First Person Pronouns (or *I*) is always used more than Third Person Pronouns during truth telling. DePaulo et al. (2003) explain increases in Third Person Pronouns during deception as arising out of deceivers' preference to move focus away from themselves and their own actions by referring to others more often.

However, increased use of Third Person Pronouns appears to be more complex than simply being a case of deceivers deflecting attention away from themselves. Context matters. People use the pronouns to refer to what happened to someone else. It may be that in truthful statements, where witnesses are bystanders to an event or are emotionally more focused on a particular individual at the centre of the event (such as a child), they will concentrate on *others* more and include little of themselves in the narrative. This results in the use of higher third party references and less First Person Singular Pronouns. An example of this would be Statement no. 14, in which most of the Statement is taken up by the account of a remand prisoner as reported to the author of the Statement (another remand prisoner). Consequently, when analysing witness statements, it may be necessary to distinguish between statements where their authors are known to be largely bystanders, or whether they are actively involved in the event.

Hypothesis 3b is supported. Within Deceptive Statements, deceivers use more Third Person Pronouns when lying. It is interesting to note that episode level analysis tells a different story to whole-statement analysis. Of the 7 Deceptive Statements in which they occur, Third Person Pronouns are used more in the Deceptive episodes of 6 Statements (nos. 1-4, 6 and 9) than in Truthful episodes. These pronouns constitute 4.2% of words in Deceptive episodes, double that of Truthful episodes with 2% (Figure 46). Deceptive episodes also

[31] Machiavellian and Self-Monitoring individuals seek to gain advantage by managing impressions of themselves. Machiavellians manage impressions by bringing the behaviour of others into line with their own goals, while Self-Monitoring individuals bring their own behaviour into line with others.

contain considerably more clauses containing the pronouns at 22%, compared to 13% of clauses in Truthful episodes (Figure 47).

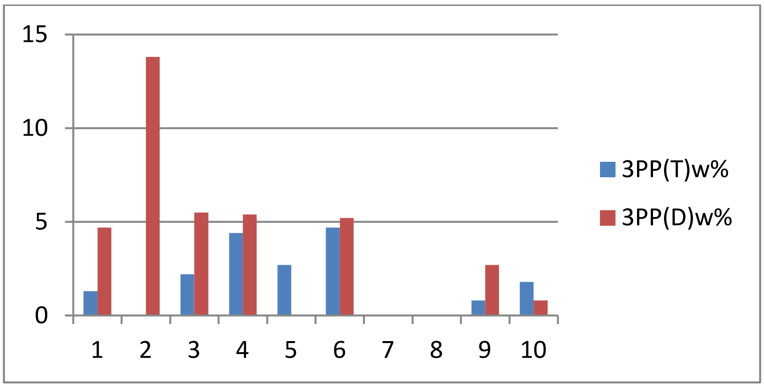


Figure 46: Known Statements - Third Person Pronouns in Episodes (Word)

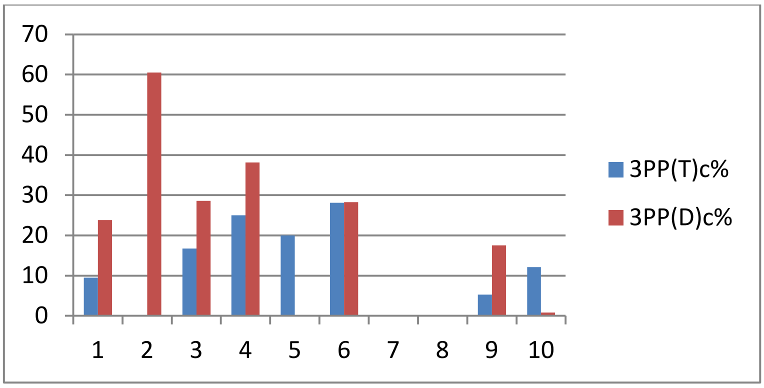


Figure 47: Known Statements - Third Person Pronouns (Clause)

As with the use of *My*, word measurement presents a slightly different picture of Third Person Pronoun use compared to clause measurement, as clauses may contain more than one of the pronouns. In one Statement (Statement no. 6) its author regularly incorporates two Third Person Pronouns in individual clauses -- *if **he** got **his** hands on the pistol **he** would take **it** away from me…because **he** turned **his** back*. In another instance, the author of Statement no. 14 includes three-pronouns in a single clause -- a*nd that **he** hooked **his** brother up with **her** sister*. (Statement no. 14)

It appears that although deceivers use less Third Person Pronouns than truth tellers in their witness statements generally, when they do use them, deceivers use the pronouns more when they are lying. Therefore, ultimately, the association between increased Third Person Pronoun use and deception appears to be maintained, but only in the context of existing deception.

Pronoun Frequencies

The distribution of pronouns between Truthful and Deceptive episodes is provided in Figure 48.

Statement No.	I (T)	I (D)	Me (T)	Me (D)	My (T)	My (D)	First Person Singular Pronouns (T)	First Person Singular Pronouns (D)	Third Person Pronouns (T)	Third Person Pronouns (D)
1	10	22	2	17	5	10	17	49	2	21
2	5	8	0	4	0	10	5	22	0	24
3	1	10	1	2	5	3	8	15	2	9
4	2	8	0	1	0	3	2	12	2	8
5	3	11	0	1	1	4	4	16	2	0
6	13	26	3	21	3	21	19	69	9	36
7	4	10	1	1	1	4	6	15	0	0
8	-	-	-	-	-	-	-	-	-	-
9	14	12	2	4	8	15	24	31	2	10
10	22	8	0	0	7	3	29	11	7	1

Figure 48: Known Statements - Pronoun Frequency in Episodes

4.2.4. Hypothesis 4

Hypothesis 4a is supported. Although Vague Pronoun References are used sparingly by both truth tellers and deceivers in the Known Group Statements (they occur only once in Statement nos. 2, 5, 7, 9 and 15), the cue constitutes a higher percentage of word count in Deceptive Statements with 0.7%, compared to 0.1% in Truthful Statements (Figure 49). Similarly, 4% of clauses contain the cue in Deceptive Statements, compared to 0.5% in Truthful Statements (Figure 50).

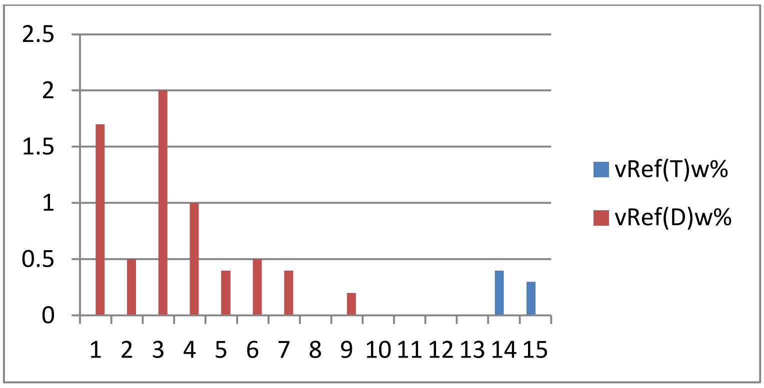


Figure 49: Known Statements - Vague Pronoun References (Word)

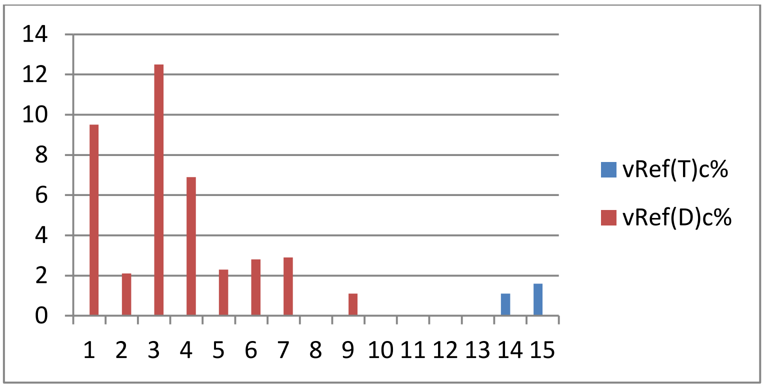


Figure 50: Known Statements - Vague Pronoun References (Clause)

It is interesting to note that truth tellers and deceivers appear to use Vague Pronoun References in different ways in this Group of Statements. In Truthful Statements, the cue is used only as a figurative reference in reported speech (Statement no. 14), or to a specific antecedent (Statement no. 15). In neither case are the authors being vague.

*I said he was **somebody*** [important] *to **somebody**, and he said you know what I mean like Ahmoud who killed that white girl. She was **somebody*** [important] *that's why he got all that time.* (Statement no. 14)

*I peeped through this crack in the tin. I saw this guy throwing wood in the burner. I told the others to be quiet because there was **someone** in there.* (Statement no. 15)

In Deceptive Statements, deceivers' use of Vague Pronoun References involves being vague about a particular aspect of the event:

*He was hitting around my left side and I felt **something** cold. He went to hit me again and **something** cut the palm of my left hand…then **someone** grabbed my wallet…* (Statement no. 1)

*He started driving and called **someone***… (Statement no. 2)

*When I unlocked the door, we could all smell **something** funny in the house*. (Statement no. 3)

It would appear that, at least as far as this group of witness statements is involved, context also matters when examining the association between Vague Pronoun References and deception.

Hypothesis 4b is also supported; at the episode level, a positive association is found between Vague Pronoun References and deception. The cue constitutes 0.9% of words used in Deceptive episodes, compared to 0.3% in Truthful episodes. Although these differences are marginal, the distribution of the cue between episodes is more telling. Of the 8 Deceptive Statements in which they are used, Vague Pronoun References occur only in the Deceptive episodes of 6 Statements (nos. 1, 2, 4, 5. 7 and 9) (Figure 51).

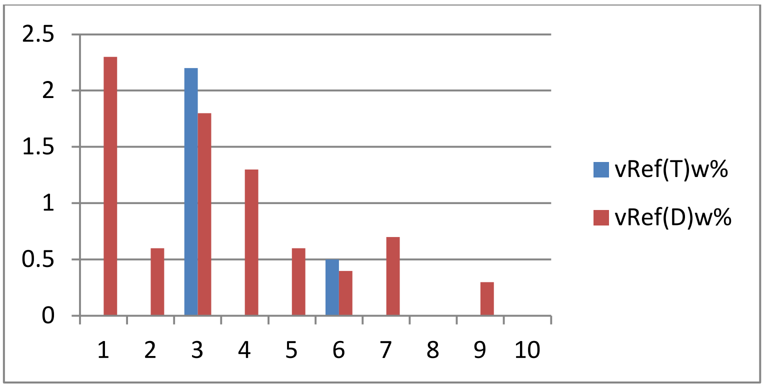


Figure 51: Known Statements - Vague Pronoun References in Episodes (Word)

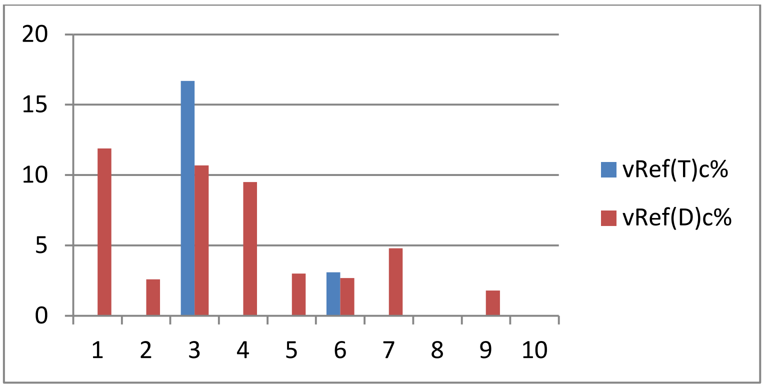


Figure 52: Known Statements - Vague Pronoun References in Episodes (Clause)

Differences in clause measurements were larger, with Deceptive episodes having 5.2% of clauses containing the cue, compared to 2.2% of Truthful episodes (Figure 52).

In two Statements (nos. 3 and 6), Vague Pronoun References are used more in their Truthful episodes. In both statements, they occur in the closing lines of the narrative:
*A couple of minutes after that, **someone** yelled that there was smoke…And that is when **someone** called 911. Then **everyone** started showing up.* (Statement no. 3)
***Everything** happened in a fraction of a second*. (Statement no. 6)

Although the cue is embedded in truthful information, it continues to reflect the ambiguity found in deceptive portions of the narrative.

4.2.5. Hypothesis 5

Hypothesis 5a is supported. On the whole-statement level in the Known Group analysis, Deceptive Statements contain more Verb Strings than Truthful Statements. Verb Strings constitute 1.4% of words in Deceptive Statements, compared to 0.9% of words in Truthful Statements (Figure 53). Clause measurement is a stronger differentiator, with 8.3% of clauses containing the cue in Deceptive Statements, compared with 4.7% of clauses in Truthful Statements (Figure 54).

Verb Strings are used in all the Deceptive Statements, and in 3 of the 5 Truthful Statements, with none found in the 2 shortest Truthful Statements (nos. 11 and 12).

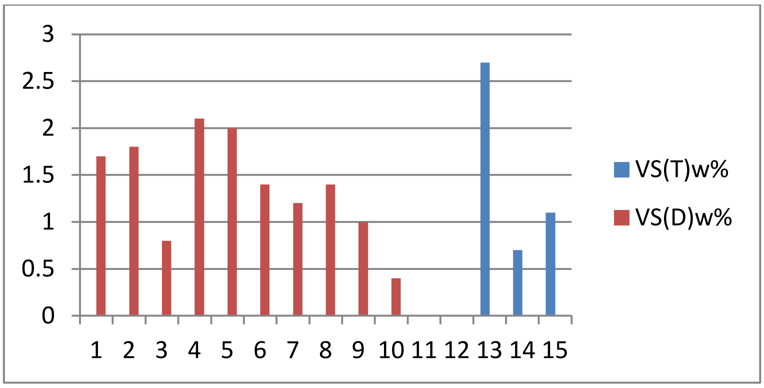


Figure 53: Known Statements - Verb Strings (Word)

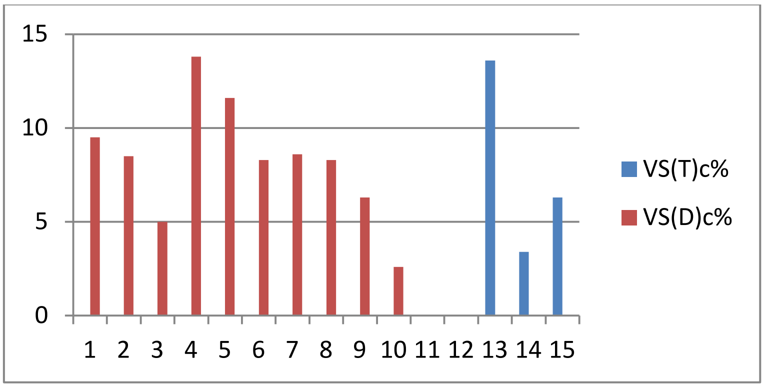


Figure 54: Known Statements - Verb Strings (Clause)

An interesting feature of some Verb Strings in Deceptive Statements is their incorporation of a Cognitive Verb (another cue investigated) in the string, e.g.

*I do **remember seeing**…what **appeared to be**…* (Statement no. 1)

*…so the employee **decided to** just **leave*** … (Statement no. 8)

*…I **remember** clearly **going** …I do **recall speaking** to …* (Statement no. 9)

I ***expected to meet*** *Sherron* … (Statement no. 10)

In addition to creating ambiguity through the conflation of verbs, incorporating a cognitive element into the Verb String introduces a further element of doubt by qualifying the information. Consequently, it is no longer a case of what happened, but what the author perceives happened.

Hypothesis 5b is also supported, and more convincingly so than Hypothesis 5a, with Verb Strings being more strongly indicative of deception at the episode level than whole statements. In three Statements (nos. 2, 4 and 5), Verb Strings are found only in Deceptive episodes; in another four episodes, the cue is used more often in Deceptive episodes. Verb Strings constitute 1.7% of words in Deceptive episodes, compared to 0.5% of words in Truthful episodes (Figure 55). The cue is also found in 9.8% of clauses in Deceptive episodes, compared to 3.7% of clauses in Truthful episodes (Figure 56).

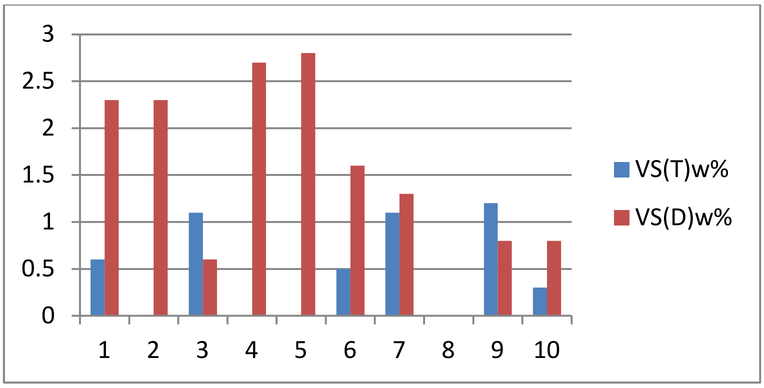


Figure 55: Known Statements - Verb Strings in Episodes (Word)

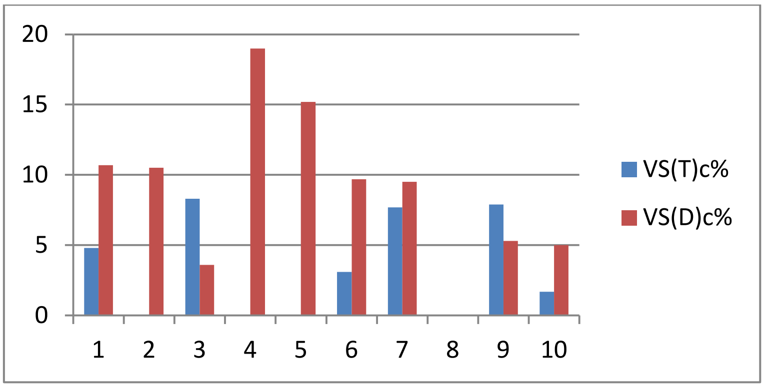


Figure 56: Known Statements - Verb Strings in Episodes (Clause)

4.2.6. Hypothesis 6

Hypothesis 6a is supported, with Deceptive Statements making higher use of Negation than Truthful Statements. Like Verb String, Negation clauses are a stronger differentiator than word measurement. The differences between deceivers' and truth tellers' use of Negation, as a percentage of word count is marginal, with Negation constituting 1.1% of Deceptive Statements and 0.7% of Truthful Statements (Figure 57). However, the cue is found in 7% of Deceptive Statement clauses, more than double the 3.1% in Truthful Statement clauses (Figure 58).

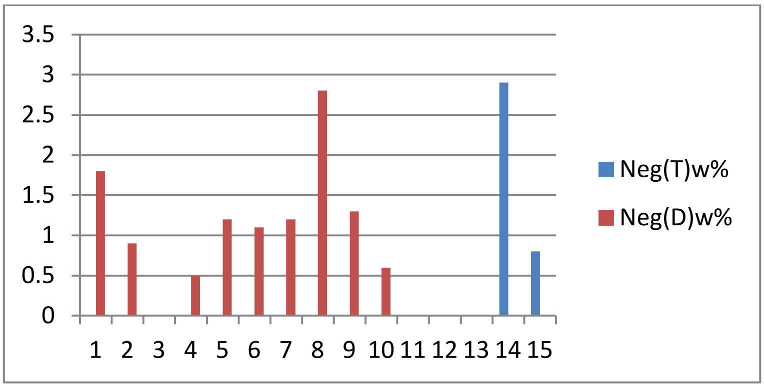


Figure 57: Known Statements - Negation (Word)

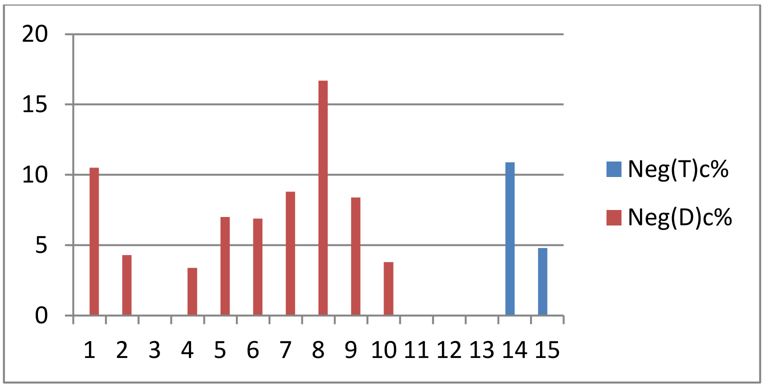


Figure 58: Known Statements - Negation (Clause)

On the whole-statement level, 9 of the 10 Deceptive Statements use Negation, compared to only 2 Truthful Statements. One Truthful Statement (no. 14) contains a high percentage of Negation clauses, only second to the highest Deceptive Statement usage (Statement no.8). However, on inspection of Statement no. 14, 18 of the 19 clauses containing Negation are to be found in reported speech, as in the excerpts:

*I said while in my cell you **won't** kill **nothing** or let **nothing** die with your bitch ass!*

*So then Jake said in his case that the state **don't** have any evidence. I said they **don't** have the gun. He said **no** I sold the gun to a friend.*

*I said that's why you **aint never** going home, Sheffield **don't** play that murdering people shit.* (Statement no. 14)

In contrast, in Deceptive Statements, most Negation involves describing the event in terms of what did not happen.

*I **didn't** really know if he tapped me or **not***… (Statement no. 1)
*I **wouldn't** talk to him…* (Statement no. 4)
*I **didn't** recognize the name…but I **can't** remember them right now…* (Statement no. 6)

A few Negations also involve distinguishing between what is and what is not the case, as in the excerpts:

*I do remember seeing headlights behind me right before the curve …but **not** before then …* (Statement no. 1)
*I thought maybe I hit him but I **didn't** hit him*. (Statement no. 2)
*It was similar to this but **not** exact*. (Statement no. 6)
*a female …tried to walk past me and **not** go through the metal detector* … (Statement no. 8)
*I expected to meet Sherron …Sherron did **not** show up* … (Statement no. 10)

Newman et al. (2003) suggest that deceivers use fewer *exclusive* words (e.g. *but, except, without*) which are used to distinguish between *what is* and *what is not* in a category, as deceivers would not normally have the cognitive resources to juggle such information. However, deceivers do regularly distinguish between what is and what is not the case in their Statements, and use Negation as part of the process. Deceivers appear to make this distinction in the context of what they *think* is the case, but it turns out that it is not. Perhaps using verbs to suggest an assumption or other cognitive function (e.g. *thought*, *tried to*, *expected*) which they then negate allows deceivers to justify a behaviour, even if it might later be found out to be incorrect.

Hypothesis 6b is also supported, with Deceptive episodes having a higher percentage of Negation than Truthful episodes in 7 of the 8 statements where Negation is used; in 2 of those Statements (nos. 2 and 4), Negation is only used in their Deceptive episodes.

Negation constitutes 0.9% of words found in Deceptive episodes, compared to 0.7% in Truthful episodes (Figure 59). The cue occurs in 6% of Deceptive episode clauses, compared to 4.9% of Truthful episode clauses (Figure 60). Negation clauses appear to be a stronger differentiator between deception and truth telling measured on a whole-statement level, unlike Verb String clauses which are more strongly associated with deception at the episode level.

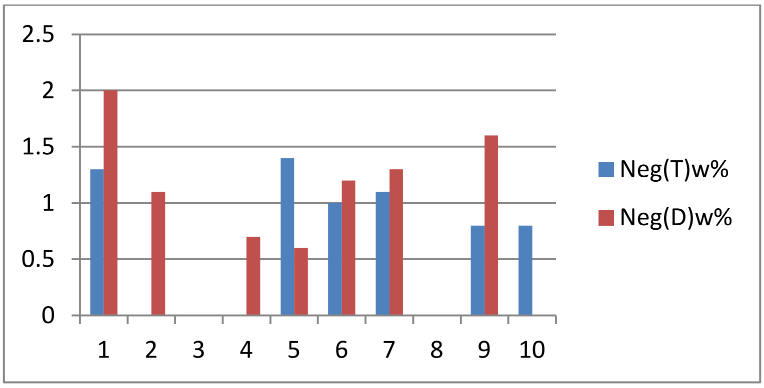


Figure 59: Known Statements - Negation in Episodes (Word)

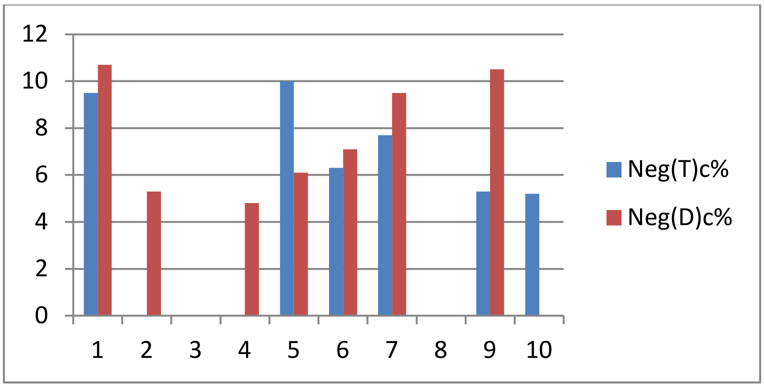


Figure 60: Known Statements - Negation in Episodes (Clause)

4.2.7. Hypothesis 7

Hypothesis 7a is supported in the Known Group 1 analysis. Cognitive Verbs are used in all 10 Deceptive Statements and in 4 Truthful Statements. Using word measurement, the difference between Deceptive and Truthful Statements is marginal.

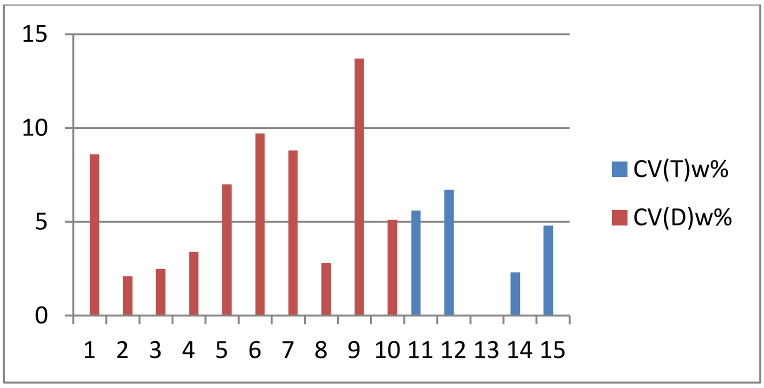


Figure 61: Known Statements - Cognitive Verbs (Word)

Cognitive Verbs constitute 1% of words found in Deceptive Statements, compared to 0.6% in Truthful Statements (Figure 61). As with earlier cues, the difference using clause measurement is larger, with 6.4% of clauses in Deceptive Statements containing the cue, versus 3.9% of clauses in Truthful Statements (Figure 62).

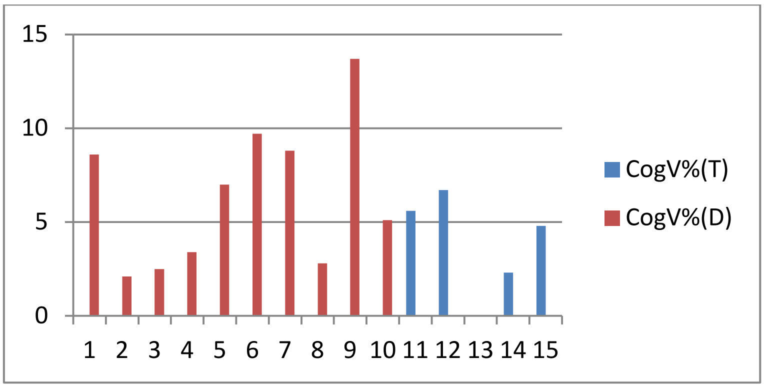


Figure 62: Known Statements - Cognitive Verbs (Clause)

Although both truth tellers and deceivers use Cognitive Verbs, they appear to use them differently. In the Known Group Statements, truth tellers use Cognitive Verbs on their own, e.g.

I ***guess*** *he got mad … I* ***think*** *he said* … (Statement no. 14)

he didn't ***know*** *… It* ***looked*** *like* … (Statement no. 15)

Deceivers use Cognitive Verbs on their own too, but also incorporate them into Verb Strings, a usage not found in the Group 1 Truthful Statements, e.g.

I do ***remember seeing*** *headlights …I drove what* ***appeared to be*** *20ft to 30ft* … (Statement no. 1)

I ***recall walking*** *… I* ***remember walking*** … (Statement no. 7)

I ***remember*** *clearly* ***going*** *…and do* ***remember paying*** *most of my attention …Can not* ***seem to decifer*** … (Statement no. 9)

By assimilating the two cues, the information provided is identified as a personal impression, a product limited by memory or perception, which could turn out to be incorrect. For the most part, it also changes the tense of that portion of the narrative from past to present; it is no longer a case of what happened, but what the author believes at the time of the writing of the statement. The change in tense is a feature that *statement analysis* practitioners believe is indicative of deception, as in the excerpt -- *I* ***turned*** *left into 31st and* ***proceeded*** *on through* *town. I do **remember seeing** headlights behind me right before the curve by the Chagford trail crossing* … (Statement no. 1)

SCAN Analysis states that past events should be told in the past tense, and that changes in tense from past to present needs further investigation (Nahari et al. 2012). However, this is contradicted by research (Ebesu & Miller, 1994; Taylor, 2005) which reports that, in fact, deceivers use fewer present tense verbs than truth tellers.

Hypothesis 7b is also supported. At the episode level, there is a positive correlation between Cognitive Verbs and deception. Cognitive Verbs are used exclusively in the Deceptive episodes of 5 Statements (nos. 2, 3, 4 and 7); in 2 other Statements, they are used more often in Deceptive than Truthful episodes. Cognitive Verbs constitute 1.3% of words in Deceptive episodes, compared to 0.7% in Truthful episodes (Figure 63). The cue is also found in 7.8% of Deceptive episode clauses versus 4.8% of Truthful episodes (Figure 64).

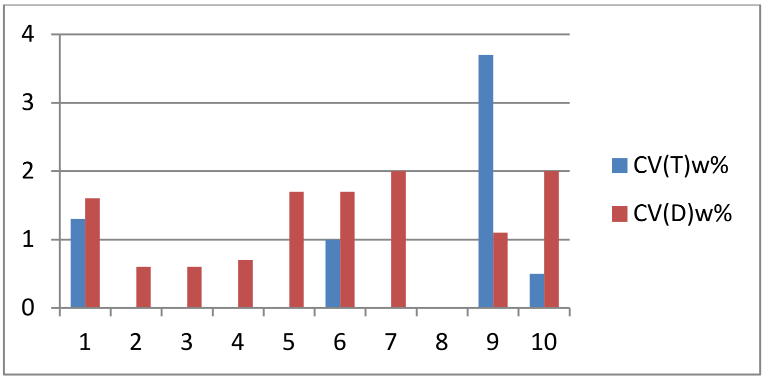


Figure 63: Known Statements - Cognitive Verbs in Episodes (Word)

Like Verb Strings, Cognitive Verbs appear to be a strong differentiator of truth and deception at the episode level. Given that Cognitive Verbs are sometimes incorporated into Verb Strings, it may be that a combination of the two could be a more productive cue than looking at the features individually. This multi-cue approach is explored in Hypothesis 8.

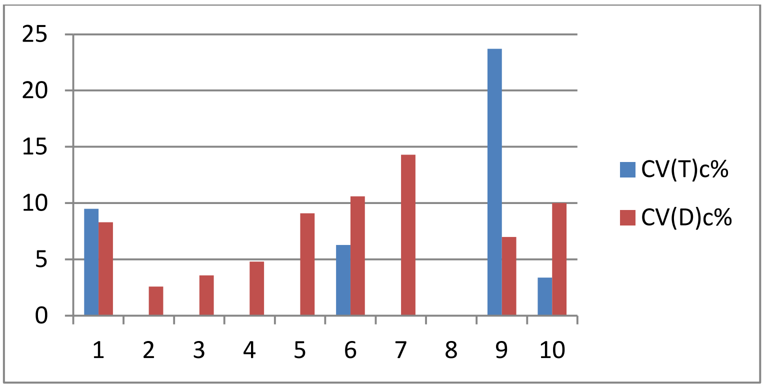


Figure 64: Known Statements - Cognitive Verbs in Episodes (Clause)

4.2.8. Hypothesis 8

Hypothesis 8a is very strongly supported, with Deceptive Statements containing a high percentage of MoDs compared to Truthful Statements. MoDs constitute 4.4% of words in Deceptive Statements, compared to 2.6% in Truthful Statements (Figure 65). The cues in combination are also found in 22.2% of clauses in Deceptive Statements, nearly twice the 11.6% of clauses found in Truthful Statements (Figure 66).

Compared to the other features analysed, MoDs are by far the largest differentiator between Deceptive and Truthful Statements, confirming DePaulo et al.'s (2003) suggestion that cues in combination are more productive deception markers than single cues.

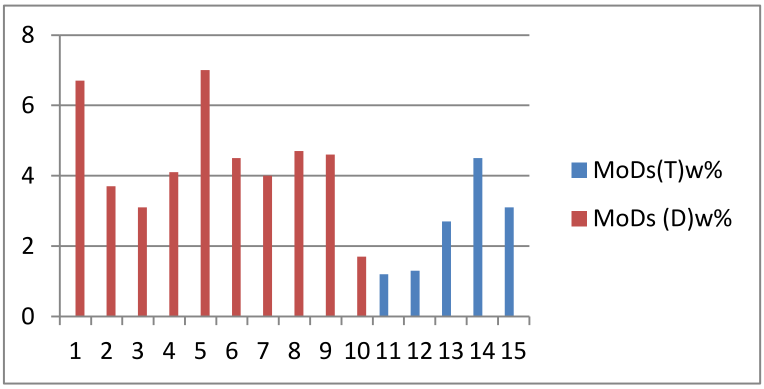


Figure 65: Known Statements - Combined Cues (Word)

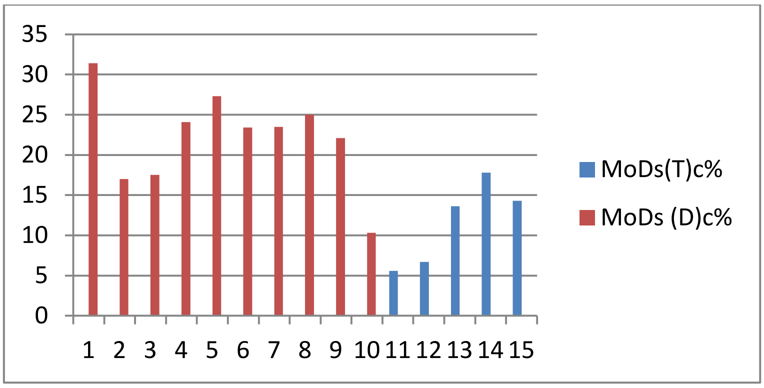


Figure 66: Known Statements - Combined Cues (Clause)

In this analysis, 2 Statements stand out from the rest in their categories, which merits closer inspection: Statement no. 10 (the 5-day narrative), which has very low use of MoDs in comparison to the other Statements in its Deceptive category, and Statement no. 14, which has high a level of MoDs compared to the other Statements in its Truthful category.

Statement no. 10's MoDs score is low because the author includes in the narrative the events of four days in addition to the day of the criminal incident. On the other hand, Statement no. 14's score is very high because it contains a great deal of quoted discourse (with and without quotation marks) e.g. "*I said…he said…so then I said…he said*", in which much of the cues analysed are found. The content of these two narratives influence cue measurements, resulting in lower than average values in the Deceptive group (for Statement no. 10), and higher than average values in the Truthful group (for Statement no. 14). However, the removal of these 2 Statements does not change the ultimate conclusions.

Hypothesis 8b is also supported, with Deceptive episodes having nearly twice the use of MoDs than Truthful episodes. Of the 9 Deceptive Statements, higher percentages of clauses containing features from the MoD set are found in the Deceptive episodes of 7 Statements. MoDs constitute 4.8% of words in Deceptive episodes, double the 2.3% found in Truthful episodes (Figure 67); MoDs are also found in 25.1% of Deceptive episode clauses, compared to 12.9 of clauses in Truthful episodes (Figure 68).

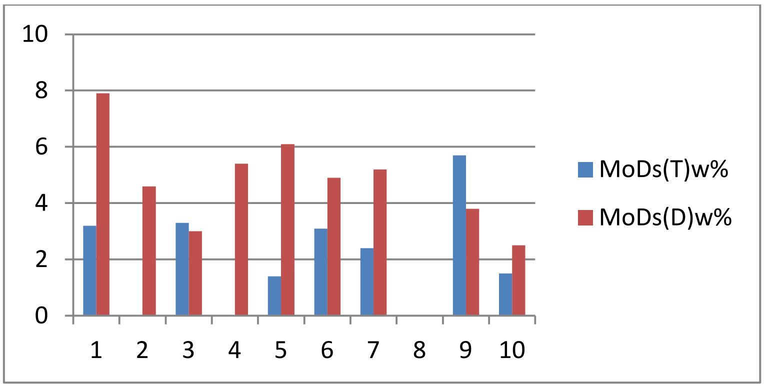


Figure 67: Known Statements – Combined Cues in Episodes (Word)

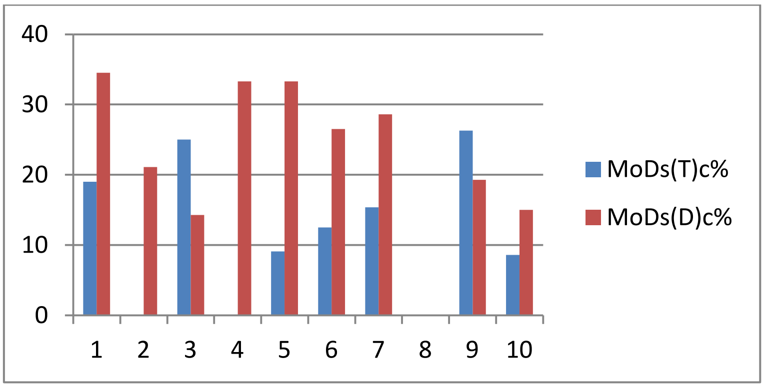


Figure 68: Combined Cues in Episodes (Clause)

In 2 Statements (nos. 2 and 4), MoDs are found only in their Deceptive episodes, and occur more often in the Deceptive episodes of 5 other Statements (nos. 1, 5-7 and 10).

Statement No.	VPR (T)	VPR (D)	VS (T)	VS (D)	Negation (T)	Negation (D)	CV (T)	CV (D)	MoDs (T)	MoDs (D)
1	0	10	1	9	2	9	2	7	5	35
2	0	1	0	4	0	2	0	1	0	8
3	2	3	1	1	0	0	0	1	3	5
4	0	2	0	4	0	1	0	1	0	8
5	0	1	0	5	1	2	0	3	1	11
6	1	3	1	11	2	8	2	12	6	34
7	0	1	1	2	1	2	0	3	2	8
8	-	-	-	-	-	-	-	-	-	-
9	0	1	3	3	2	6	9	4	14	14
10	0	0	1	1	3	0	2	2	6	3

Figure 69: Known Statements - MoDs Frequencies in Episodes

4.3. Discussion

In this study, support is found for the hypothesis that deceivers use more words; however, there is no support for the hypothesis that deceivers use more words when lying. While whole-statement analysis suggests than deceivers are more verbose than truth tellers (as measured by clause length), episode level analysis suggests that this verbosity is concentrated around deceivers' truth telling, and not their lying.

Deceivers tend to break up their narratives into shorter episodes than truth tellers. This fragmentation becomes more severe for imagined events, resulting in a succession of very short episodes during deception.

Support is found for an association between Vague Pronoun References, Verb Strings, Negation, Cognitive Verbs and deception. Some cues are more strongly associated with deception on the whole-statement level, while others work better at the episode level. Vague Pronoun References and Negation differentiate between deception and truth telling when analysed on the whole-statement level and taking the higher results. Verb Strings and Cognitive Verbs are more productive at the episode level, narrowing down the focus to where deception is occurring in the narrative. Vague Pronoun References also appear to be a good discriminator at the episode level.

The hypothesis regarding MoDs is also supported, confirming DePaulo et al.'s (2003) report that looking for combined features is more productive in identifying deception than relying on individual cues. MoDs appear to be good discriminators at both the whole-statement (using the higher-end values) and episode level.

There is no support for a negative correlation between deception and First Person Singular Pronouns, with Deceptive Statements using a slightly higher percentage of clauses containing the pronouns, contrary to previous studies. While there is little difference between truth tellers' and deceivers' use of *I*, deceivers use more *Me* and considerably more *My* than truth tellers. This suggests that individual First Person Singular Pronouns are not equally weighted, and that deceivers and truth tellers juggle their use of self-references differently. This subtle balancing of pronouns is more readily appreciated at the episode level, where Deceptive Statements make more use of *Me* and *My* in their Deceptive episodes.

This complex scenario also applies to Third Person Pronouns. There is no support for a positive correlation between deception and the pronouns at the whole-statement level;

deceivers, it appears, use Third Person Pronouns less than truth tellers. This agrees with Newman et al.'s (2003) finding of a reduction in Third Person Pronoun use during deception. However, at the episode level, the situation is reversed; deceivers do use the pronouns more than truth tellers, thus maintaining the association between Third Person Pronouns and deception.

To summarise, deceivers generally differ from truth tellers in that deceivers' Statements are more verbose and more ambiguous. Deceivers maintain author involvement throughout their Statements largely to the same extent as their truthful counterparts, but subtly juggle their degree of involvement with the information they provide, resulting in increased passive participation in Deceptive episode while maintaining immediacy.

Deceivers and truth tellers also construct their narratives differently. Deceivers create a succession of short episodic structures when lying, which are seen less in truthful narratives. Within Deceptive Statements, deceivers devote more episodes to the deception, although they construct longer clauses during truth telling. Deceptive episode also contain more self-references *Me* and *My*, and Third Person Pronouns, as well as a higher percentage of MoDs.

Not part of the analysis but an interesting point nonetheless is the inclusion in narratives of the events of more days than is relevant to the criminal incident. Johnson & Raye (1981) report in their Reality Monitoring studies that real memories tend to provide supporting information in the form of events before and after the incident being recalled, as opposed to fabricated memories. In the witness statements used in this study, the opposite is found. In the Known Group Statements, 4 of the 10 Deceptive Statements contain references to events the day(s) before and/or after the day of the incident, which does not happen in Truthful Statements. Johnson & Raye do not say how much time (whether hours or days) before and/or after the incident one can expect to be included in the memories. It may be that, in the case of these Statements, deceivers believe it may add to their credibility if they anchor the false events to truthful information beyond the incident day, while truth tellers concentrate on what they believe is important, the event itself. This is consistent with DePaulo et al. (2003), who report that deceivers tend to refer to events other than the main incident, as opposed to truth tellers, who concentrate on the event in question.

4.4. *Linguistic Strategies for Deception*

If it is accepted that the linguistic style of deceivers differ from that of truth tellers (Knapp, Hart & Dennis, 1974; Knapp & Comadena, 1979; Kuiken, 1981; Vrij, 1995; Buller & Burgoon, 1996; Anolli, Balconi & Ciceri, 2002; Anolli, Balconi & Ciceri, 2003), then it follows that deceivers may also linguistically structure the deceptive and truthful portions of their statements differently.

It is in deceivers' interest that their addressees assume they are being cooperative. Deceivers hope to appear cooperative (and by extension, truthful) by providing information in witness statements that addressees will think is material to the course of the investigation. Although deceivers must provide two types of information (truthful and deceptive), their intention is that addressees infers only a single truthful message populated with information relevant to the purpose of the statement. To achieve this, deceivers must manipulate both truthful and deceptive information to construct a seamless narrative, adjusting their language accordingly so that the story appears cohesive and credible. The boundary between truth and lies must be blurred so that the transition between one to the other is softened and the readers' default assumption of continuity is maintained (Segal, Duchan & Scott, 1991).

However, deceivers cannot use the same language for both truthful and deceptive content simply because they cannot provide the same detail of information for both. Thus, deceivers' linguistic strategy must accommodate their intention to present deceptive information as if it were true, as well as appear sincere so that addressees will believe the message to be true. Deceivers want their addressees to believe that their lies are the truth without addressees realising they are being lied to. This requires that deceivers adopt a linguistic strategy that presents deceptive information in such a way that addressees consider it relevant and connect it with the rest of the information (both truthful and deceptive) in the statement; as a consequence, the whole statement should meet addressees' expectations of truthfulness[32] (Wilson & Sperber, 2000; Wilson & Sperber, 2002). At the same time, should addressees not be convinced of the information's relevance or truthfulness and become suspicious, then the linguistic strategy adopted might also allow deceivers leeway to excuse the misinformation as the result of confusion or lack of information.

[32] Wilson & Sperber (2000) assert that "expectations of truthfulness are a by-product of expectations of relevance", and not the other way around (p. 216).

Changes in linguistic style during deception have been observed in previous studies. Research into deceptive communication reports that there is no such thing as a single deceptive communication style and that deception is an adaptive strategy. Buller, Strzyzewski & Hunsaker (1991) explain the logistics of deceptive conversation as "characterised by a series of moves and countermoves, and deception's ultimate success or failure is affected by the skill of both communicators to see through the multiple layers of meaning and react in ways which further their goal."[33] (p. 28)

In his *Information Manipulation Theory* (IMT), McCornack (1992) proposes that deception is achieved through violation of Grice's conversational maxims, and that deceivers can choose from any number of strategies that involve manipulating the *amount, veracity, relevance*, and *clarity* of the information as and when circumstances require it. In their *Interpersonal Deception Theory* (IDT), Buller & Burgoon (1994) also see deceptive communication as a constant tweaking of linguistic (and non-verbal) behaviour by deceivers in response to their addressees' reactions. In both theories, the deception strategy is flexible as this ensures that maximum success may be achieved for the deception and, at the least, protect deceivers from being caught lying outright.

Anolli, Balconi & Ciceri (2002) bring together a variety of deceptive strategies identified by other researchers under "one family of deceptive acts" in their *Deceptive Miscommunication Theory* (DeMiT). They suggest that the selection of a particular linguistic strategy at any one time is dictated by the context in which the deception occurs and whether it is pre-planned or spontaneous. In particular, the choice of strategy is influenced by addressees' attitude towards their deceivers, whether addressees are silent or acquiescent recipients of the information, or questioning and suspicious. The ability to strengthen or weaken the message in response to addressees' behaviour not only allows deceivers flexibility to protect themselves from discovery, but also allows them to meet addressees' expectations as to what might constitute normal truthful communication (Dunbar, Ramirez & Burgoon, 2003).

However much pre-planning may go into a deception, deceivers still have to evaluate every response in order to optimise their chances of success. Given that there are multiple strategies to choose from when telling the truth, never mind when lying, and given that deceiver may make any number of adaptations every time they take a turn, deceptive communication in a face-to-face or textual CMC messaging context can be a complicated affair.

[33] Reproduced with permission from Taylor & Francis.

Communication theories such as IMT, IDT and DeMiT describe face-to-face deceptive conversation strategies, but none address linguistic strategies adopted by liars in written narratives such as found in witness statements. For a start, the witness statement is a written monologue; there is no turn taking and no opportunity for feedback. In theory, without the instant feedback resource available in face-to-face communication, there would not be the need or the incentive for deceivers to change their approach once they decided on a particular strategy and embarked on writing their statement. However, differences in the concentration of linguistic features within Truthful and Deceptive episodes found in this study suggest that deceivers do use language differently within a single statement when lying and telling the truth.

Written deception may appear simpler than face-to-face deception because there is no addressee to adapt to; but it has its own complications. Deceptive witnesses may have thought out their story, but translating the false account into words on paper and seamlessly fitting it in with the known facts is not straightforward. Even with time to plan the narrative and produce the statement, deceivers still have to decide how to convey their false account in a way that will appear balanced and consistent with the known truths and therefore, convincing. Deceivers have to tread a fine line between providing enough information, without providing too much which might be verified easily. They have to provide a necessary minimum, which by itself might not be very convincing, but that minimal lie can be padded out with irrelevant truths and suitably ambiguous and difficult-to-confirm information, which would make deceivers at least appear to be trying to be helpful and, consequently, more likely to be believed. In addition, deceivers have to blur the boundary between truth and lies so that the transition between one to the other is softened and readers' default assumption of continuity is maintained (Segal, Duchan & Scott, 1991). At the same time, deceivers prefer not be too closely associated with the lie as it might be stressful, or too dangerous; keeping personal association with the false information in the narrative to a minimum, without being suspiciously absent, would help.

4.4.1. Deception as a *Progression*

Research in general has tended to examine deception as if it were black and white, a separate communication activity with specific identifiable characteristics which distinguish it from normal truth telling. Anolli, Balconi & Ciceri (2002) argue that this perception is a myth, that deceptive communication is no different from default truthful communication. What makes deception different is its *internal gradient*, the series of successive changes to the language that allows deceivers to design a strategy best suited to their particular situation.

Baumeister (1993) sees deception as arising out of a graduation of “possibilities, probable truths, working assumptions, leaps to conclusion” (p. 167), particularly with reference to self-deception. Convincing oneself and others of the truth of shades of grey is easier than believing black to be white.

Previous research has also tended to approach deceptive communication as if it consists of a single act, reflected in a single statement or a single interview. Literature and legislation often refer to an *act of deception*, as if it happens in a single moment. In fact, deception is a progression of acts over time (White & Burgoon, 2001), a continuous process rather than a one-time event (Zhou, Burgoon & Twitchell, 2003), where information is managed and manipulated to achieve a final deceptive presentation. When deception is examined as a single act, it would be easy to miss the more subtle behaviours that are more easily identifiable when the graduated process is examined.

Consequently, if one subscribes to White & Burgoon (2001) and Anolli, Balconi & Ciceri (2002), it makes sense that deception cues will change over the progression of the deception. Indeed, evidence exists in support of this. Zhou, Burgoon & Twitchell (2003) report that deceptive cues vary over the time of the deception in quantity and type. In their study involving email exchanges between truthful and deceptive senders over three days, none of the cues are effective differentiators between truth and deception for all of the days, with some cues stronger at one particular stage of the deception than at others. In particular, Zhou et al. find that deceivers make significantly high use of negative effect on Day 1, which they surmise results from deceivers exhibiting more negative arousal and cognitive loading at the start of their deception. Zhou et al. also find that deceivers use significantly more verbs and modifiers than truth tellers on the first day of the deception, and they continue significantly high (albeit at a lower rate that Day 1) on Day 2. Self-references also become significant on Day 2. However, by Day 3, all the cues disappear, suggesting that deceivers may become accustomed to their addressees and/or increasingly confident with their deception as it progresses. Zhou et al. are unsure whether the time difference (over several days), or the stage of the deception, or a combination of the two influence the use of cues. Irrespective of this, what is important in their study is the linguistic analysis of an unfolding deception strategy.

Unlike face-to-face and CMC messaging, in producing written statements, there is no turn taking which can be analysed independently of each other. However, individual narratives which are subdivided into episodes, and the progression of these episodes (through which the deception unfolds) does lends itself to analysis.

According to DeMiT (Anolli, Balconi & Ciceri, 2002), “focus is driven by intentions and guided by the route the communicator formulates to move through the field of thought”[34] (p.84). In other words, language is influenced by the authors’ focus, and that in turn is managed by what those authors intend to do and how they intend to achieve it. In terms of deception, the finished product (the deception) is a compilation of deceivers’ intentions (to tell the truth or to lie) and choice of communication strategy to achieve that intent. Linguistic analysis of individual episodes allows us to map how deceivers move *through their field of thought*. At the very least, examining changes in language across different episodes in deceptive statements provides an opportunity to identify their authors’ linguistic strategies for deception building, and how they juggle cues (which may be associated with deception) within the statements.

4.4.2. Strategic Association of Cues

To examine the progression of deception within individual statements, the linguistic features in the 10 Deceptive Known Statements were analysed for their interaction with each other on a whole-statement and episode basis. Only cues with the very highest percentages (higher than percentages found in the Truthful Statements) were identified and any associations analysed; these form the basis of the linguistic deception strategies identified.

The highest use of MoDs clauses (≥23%) (Statement nos. 1, 4, 5, 6, 7 and 8) were associated with:

- longest clauses (≥7 words per clause) (Statement nos. 4, 5, 7, 9 and 10); and
- highest use of *I* clauses (≥30%) (Statement nos. 1, 4, 5, 7 and 10).

Statements containing the highest use of First Person Singular Pronoun clauses (Statement nos. 1, 2, 6, 7, and 9) were also associated with very high use of *My* clauses (≥15% of clauses) (Statement nos. 2, 3, 6, and 9; nos. 1 and 7 were 14% and 13% respectively).

[34] Reproduced with permission of IOS Press and M. Balconi.

Statement No.	I clause %	Me clause%	My clause%	First Person Singular Pronoun clause%	Third Person Pronoun clause%	MoDs clause%	Words/ clause
1	30	17	14	59	21	31	5.7
2	28	8	19	53	49	17	5.1
3	27	7	15	37	25	17	6.7
4	34	3	10	45	34	24	7.4
5	33	2	9	39	5	27	7.1
6	27	17	15	54	28	23	6.4
7	41	6	15	56	0	23	7.2
8	8	6	8	17	50	25	5.5
9	27	6	24	50	13	22	7.5
10	38	0	13	46	10	10	7

Figure 70: Known Deceptive Statements - Frequency of Cues (Clauses)

compared to:

Statement No.	I clause %	Me clause%	My clause%	First Person Singular Pronoun clause%	Third Person Pronoun clause%	MoDs clause%	Words/ clause
11	39	6	6	44	17	6	4.6
12	33	0	13	47	33	7	5.1
13	25	14	4.	41	36	14	5.1
14	24	2	2	28	53	18	4.7
15	33	3	3	40	19	14	5.6

Figure 71: Known Truthful Statements - Frequency of Pronouns (Clauses)

The association between high levels of First Person Singular Pronoun clauses and *My* clauses suggests that it may be the increase in *My* levels that is pushing up the First Person Pronoun count to beyond Truthful levels. When the percentages of *I*, *Me*, and *My* clauses constituting First Person Singular Pronoun clauses were analysed, this was indeed the case. Of the 5 Statements with the highest *My* clause levels (Statement nos. 2, 3, 6, 7 and 9), 4 Statements also contain the lowest *I* levels (Statement nos. 2, 3, 6 and 9).

Two Statements (nos. 2 and 8) differed from the others in that they had the highest use of Third Person Pronouns (49% and 50% of clauses respectively) and the shortest clauses (≤5.5 words per clause), while 4 Statements (nos. 5, 7, 9 and 10) with the lowest use of the pronouns (≤ 28%) also contained the longest clauses (≥7 words per clause).

Thus, two main deceptive strategies can be suggested through the association of cues analysed on a whole-statement basis (without having to look at the episodes individually). However, what the whole-statement analysis fails to communicate is how the deceptive strategies work; this requires episode analysis.

4.4.3. Strategy 1 - Prolix and Personal

This strategy can be described as verbose, personal, and ambiguous. Their authors use many words and longer clauses. They use a high number of First Person Singular Pronouns, which ensure that the authors are normally present in one form or another in the narrative, probably intended to promote an appearance of immediacy. Distancing is achieved through high use of *My* and, at times, *Me*. Clauses containing *I* are more likely to be associated with *MoDs*, which tend to cluster together, acting as dubitative modifiers and creating ambiguity in the actions being described.

In this strategy, the author's intention is to be cooperatively vague, saying more than is necessary or relevant. Deceivers want to appear helpful by providing plenty of information in which they maintain a presence, but which is rendered safe through irrelevancy and ambiguity.

This distancing strategy, whereby deceivers are verbose but noncommittal, is described in earlier literature by Knapp, Hart & Dennis (1974), Kuiken (1981), Dulaney (1982), Buller & Burgoon (1994), and Hancock et al. (2005). Anolli, Balconi & Ciceri (2002) suggest that this combination of verbosity and ambiguousness is the likely strategy adopted by deceivers facing non-responsive or acquiescent addressees. In a witness statement context, it may be that writing for a faceless and non-interactive addressee results in the same effect.

Statement no. 1 is one example of this strategy (Figure 72). Overall, the Statement makes high use of First Person Singular Pronouns (59% of clauses), which is inflated through very high use of *Me* clauses (17%). *I* dominates in Episode 1, which sets the scene for the deception, (which progresses through the next six episodes). However, the author gradually increases his use of *Me* and *My*, until their combined use sidelines *I*, and the author effectively disappears as an active individual. Where *I* is present, it is largely associated with ambiguous activity and subjective information (created through the use of MoDs) which pad out the narrative without actually contributing anything relevant to it, as in the excerpt:
*next thing **I remember** it the driver on top of **me** punching **me** around **my** chest and **I trying to grab** arms. **I** held his right arm but he was still moving it like a punching motion. He was hitting around **my** left side and **I** felt **something** cold. He went to hit **me** again and **something** cut the palm of **my** left hand and it scared the hell out of **me** so **I** grabbed **my** side curled up and **started yelling** and screaming*. (Statement no. 1)

Figure 72: Episode Progression of Cue Usage in Statement no. 1

This juggling of pronouns and MoDs is captured in the following pie charts, one for every episode in Statement no. 1. The two very short episodes (Episodes 4 and 5) with only 2 and 3 clauses each respectively, have been excluded as the small number of clauses create artificially high measurements.

As the deception progresses (from Episode 1), *I* is overshadowed by increases in *Me* and *My*, and combined with increasing use of Third Person Pronouns to distance the author from active participation in the incident. *MoD* clauses remain as high as *I* clauses (as most MoDs clauses as associated with the author's actions) or higher, suggesting action rather than clearly defining it. The last episode (Episode 8 - Truthful) is a short unambiguous one of 4 clauses, however, with the focus still directed away from the author.

4.4.4. Strategy 2 – Impersonal

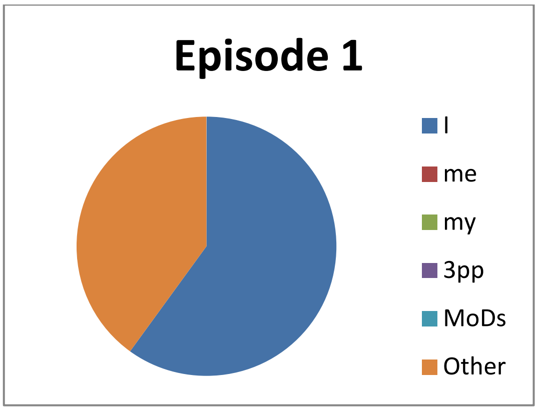
Strategy 2 involves creating an impersonal context, a strategy previously identified by Buller & Burgoon (1994), and referred to by Anolli, Balconi & Ciceri (2002) as *depersonalisation.*

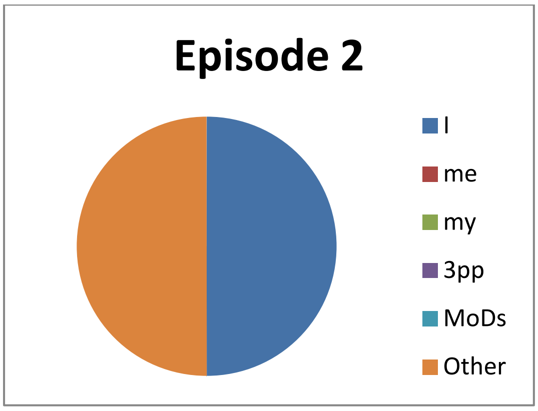
In this impersonal strategy identified in the Known Group 1 Deceptive Statements, authors reject responsibility for the action by either ascribing it to someone else, or sharing it. The main characteristics of this strategy (as identified in Statements nos. 2 and 8) is the very high use of Third Person Pronouns, short clauses, and lower levels of MoDs; however, there are a number of variations to this strategy.

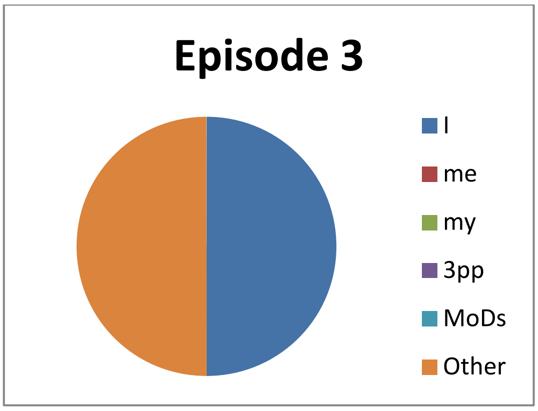
In Statement no. 2, the author makes high use of self-references as well as Third Person Pronouns. However, the high numbers of self-references is due to a combination of high use of *My* and lower use of *I* (than in Strategy 1), which the author uses in conjunction with *Me* and Third Person Pronouns to create an increasingly *other* focus, as the deception progresses through the narrative:
I *started to check on* ***him*** *and* ***he*** *pushed* ***me*** *in* ***my*** *van and then made* ***me*** *drive then* ***he*** *told* ***me*** *to stop crying.* ***He*** *told* ***me*** *to stop the van.* ***He*** *took tape out and put* ***it*** *on* ***my*** *hands and then* ***he*** *cut* ***my*** *lips with* ***his*** *knife and then put tape on* ***my*** *face*. (Statement no. 2)

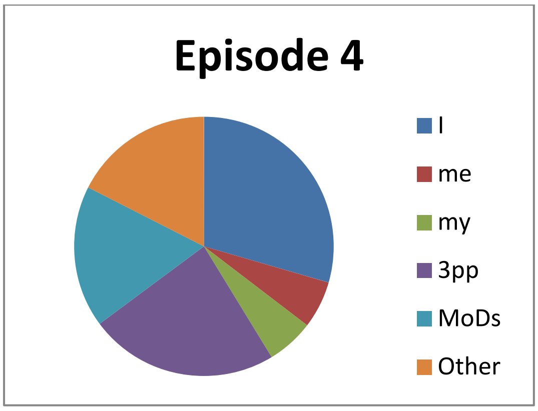
There is use of MoDs, but the cues tend to be isolated, without the clustering found in the previous strategy, probably because the author has no need of it. Ambiguity is not necessary as the author's plan is not to blur the action but to be distanced from it by ascribing it to someone else.

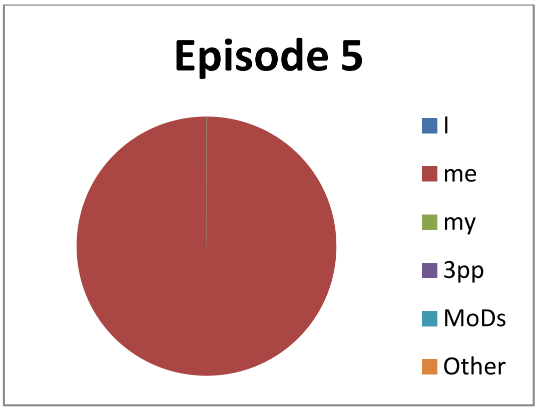
The changing balance of cues is mapped as the deception progresses through the episodes of Statement no. 2 (Figure 73). Episodes 1 to 3 provide a truthful introduction. The deception begins in Episode 4, which sees the first appearance of MoDs (all associated with *I*), as well as the beginning of a shift in focus away from the author as agent of the action (identified by use of *I*) to a more passive role (identified by increasing use of *Me* and *My*). Third Person Pronouns also make their first appearance in Episode 4 and proceed to dominate the rest of the narrative.

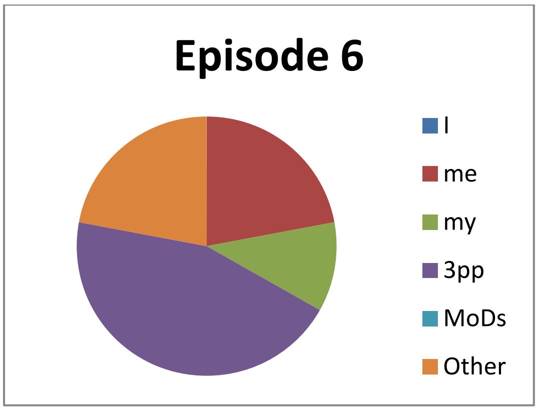

Episode 1
I
me
my
3pp
MoDs
Other

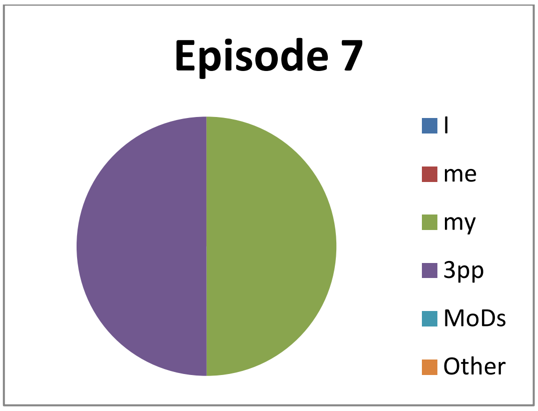

Episode 2
I
me
my
3pp
MoDs
Other

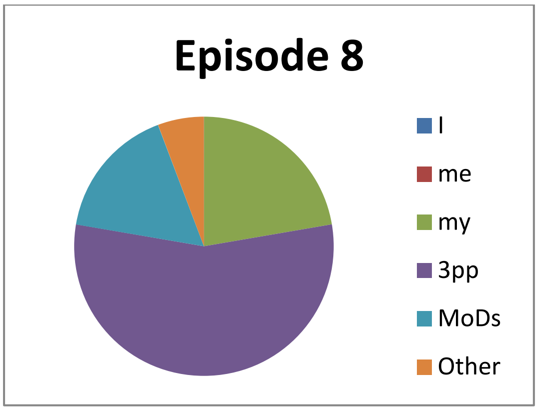

Episode 3
I
me
my
3pp
MoDs
Other


Episode 4
I
me
my
3pp
MoDs
Other


Episode 5
I
me
my
3pp
MoDs
Other


Episode 6
I
me
my
3pp
MoDs
Other


Episode 7
I
me
my
3pp
MoDs
Other


Episode 8
I
me
my
3pp
MoDs
Other

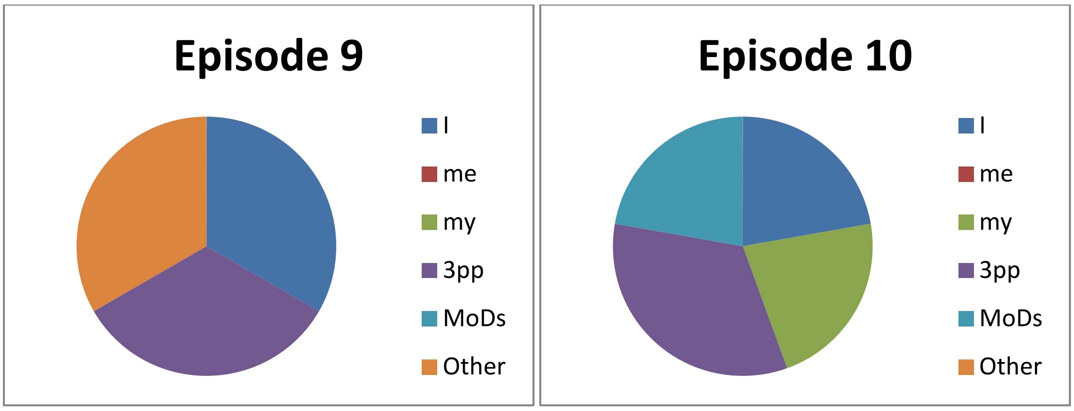


Figure 73: Episode Progression of Cue Usage in Statement no. 2

Throughout the deception, the author juggles *Me*, *My*, and Third Person Pronouns, moving from one form of distancing to another. The narrative does not return to the truthful condition and remains *other* focused to the last episode.

Statement no. 8 follows a different distancing approach (Figure 74). In this completely fictitious statement, Third Person Pronouns predominate and are found in 50% of clauses, compared to only 17% of First Person Singular Pronouns. Thus, the imbalance of pronouns identifies the depersonalised statement. Episode 1 starts impersonal, with high levels of Third Person Pronouns, which continues throughout the rest of the episodes, overshadowing any *I* presence, as in the excerpt:
a female entered the building and tried to walk past ***me*** *and not go through the metal detector.* ***She*** *told* ***me she*** *was an employee.* ***I*** *stated that* ***she*** *still had to go through the metal detector. When* ***she*** *was going through the metal detector* ***she*** *didn't put her bags on the x-ray machine.* ***She*** *put her bags on the x-ray machine in a frantic manner.* ***She*** *jumped in front of another person and pushed to the desk*. (Statement no. 8)

Figure 74: Episode Progression of Cue Usage in Statement no. 8

A third variant of the strategy is used in Statement no. 3, which achieves depersonalisation through high use of First Person Plural Pronouns. These pronouns were not included in this study as their interpretation (immediacy or distancing) is heavily dependent on the context in which they are located. *We* and *our* can be interpreted as positive indicators of group identity by the author including himself in a group with others (Pennebaker & Lay, 2002). The author could also use plural self-self references to evade responsibility by sharing it, referring to himself acting in association with others, or they can even be used in a way that excludes the author from the group (Tausczik & Pennebaker, 2010).

However, high use of First Person Plural Pronouns has the same effect as Third Person Pronouns in that their use dilutes the author's presence as an individual. In this Statement (no. 3), 40% of clauses contain either First Person Plural Pronouns or refer to the author acting together with someone else so that his actions are shared by another. The author hardly acts on his own, and the Statement's focus is effectively a collective one.
***My** wife, myself and **my** son came home today. **We** stopped and talked to **our** friend Alec downstairs. He was telling **us** …Then **me**, **my** wife, **my** son and **our** roommate Pete went upstairs. When **I** unlocked the door **we** could **all** smell something funny in the house*.
(Statement no. 3)

As in the first impersonal strategy, this variant also combines high use of *My* (15%) with lower use of *I* (27%). Together with First Person Plural Pronouns, the author maintains a sort of presence while at the same time creating an *other* focus.

4.4.5. Narrative Fragmentation

Episode fragmentation is not a linguistic strategy per se but a construction feature of narratives, subconsciously created by their authors to make it easier for their hearers or readers to follow the story. In this study, the fragmentation of sections of a narrative into short episodes appears to be associated with deception.

Fragmentation occurs when a series of short episodes (defined in this study as episodes which contain 25 words or less) follow each other which interrupts the flow of the narrative. Episodic fragmentation does not appear to be associated with any particular deceptive linguistic strategy, occurring as much in depersonalised statements as in those following a prolix and ambiguous strategy.

In this study, it is proposed that excessive narrative fragmentation may be indicative of the creation of an artificial timeline. When a sequence of events is confused or imagined, the continuity of the narrative breaks down; consequently, storytellers subconsciously create new episodes to deal with the mixed bundles of information. In an imagined event, where reported elements are unrelated to each other and not anchored in real time, narratives fragment simply because they are not anchored in real time. The stories lack cohesiveness, and so narratives break up into smaller episodes, reflecting those connective leaps that storytellers have to make between them.

It may be too that narrative fragmentation arises from deception by omission, highlighting the existence of temporal lacunae. The easiest way to deceive safely is by telling the truth and omitting incriminating information. It is less risky than other deceptive strategies as deceivers do not have to provide false information which may be disproved or contradicted; if caught out, the deceiver could always claim to have forgotten that aspect of the event (Levine, Lapinsky, Banas, Wong, Hu, Endo & Anders, 2002). In their study into the prevalence of types of violation of Grice’s maxims, Levine et al. (2002) report that, by far, the most frequent manipulation of information was that of deception by omission -- violation of the Maxim of Quantity.

Statements nos. 2 and 3 are good examples of episodic fragmentation arising out of an artificial or heavily edited (timeline) version of events. Both Statements contain the lowest words per episode count of all Deceptive Statements (and lower than any Truthful Statement). Statement no. 2 contains 217 words divided into 10 episodes (averaging 22 words/episode), with 7 of its 10 episodes marked by the use of "then", as in the excerpts: *then he told me to stop crying … and then he cut my lips … and then he put tape on my face*. Statement no. 3 contains 255 words divided into 12 episodes (averaging 21 words/episode), with 2 episodes marked by "then" and the rest by adverbial clauses stressing the importance of the time, as in the excerpts: *when my wife myself and my son came home today; then me … went upstairs; when I unlocked the door; when I came home; a couple of minutes after that; then everyone started showing up*.

As corpus studies reveals, *then* is the second most frequently used temporal adverbial (the most frequent being *now*) (Biber, Johansson, Leech, Conrad & Finegan, 2000). The problem that arises in using *then* to tag a new episode is that the word has a variety of meanings. As a circumstance adverbial, it acts as a temporal expression anchoring the information in the clause to a particular place in time i.e. *at that time*, and to temporally ordering events i.e. *after that time.* As a linking adverbial, it serves to connect clauses without inferring any temporal value (Puscasu & Mitkov, 2006).

Puscasu & Mitkov (2006) argue that only the *at that time* usage of *then* should be given a temporal value. However, in many cases in the Statements analysed in this study, it is difficult to determine in what temporal context the author uses the adverb. *Then* in the phrase *he pushed me in my van and then made me drive then told me to stop crying* could mean *at that time*, or *after that time*, or a combination of the two. What is significant is that the author chooses to uses *then* to introduce the next bundle of information when she could choose not to use the word at all, which she omits in the sentences that follow: *He told me to stop the van. He took tape out and put it on my hands*. This irregular use of *then* suggests it does not arise out of the author's habitual use but is more likely to be a segmentation marker introducing a thematic shift.

4.4.6. Compared with Truthful Strategies

While much research has been conducted on the design of deceptive messages and how they differ from truthful messages, there has been little practical work undertaken on the template of truthful communication. Anolli, Balconi & Ciceri (2003) identify truthful linguistic style as being clear, explicit, relevant, and without the pauses and response latencies that characterise deceptive speech. In other words, it is everything that deceptive speech is not.

However, deceptive strategies describe deception at the linguistic level. At the inception and planning stage, there is little that distinguishes between truthful and deceptive communication (Levine & McCornack, 1996). As with deceptive messages, truth tellers have to tailor their messages with regard to context and to the responses of their addressee. Both truth tellers and deceivers must decide how much information is sufficient to convince addressees of their truthfulness without wasting cognitive resources on the over-provision of unnecessary information, a compromise proposed by Zipf's *speaker's and auditor's economies* (1949, as cited in Horn, 2005). Grice describes this middle path requirement for effective communication in his Maxim of Quantity -- *make your contribution as informative as is required*. Horn (1984) later expands on this as being bounded by the upper-based R-Implicature -- *say no more than you must* -- which requires the least effort from speakers, and the lower-based Q-Implicature -- *say as much as you can* -- which requires providing as much (relevant) information as is necessary to hearers in order to make messages as clear as possible. Both truth teller and deceivers, therefore, share the common goal of getting across their messages as efficiently as possible.

Truth tellers and deceivers also use the same cognitive mechanisms to plan, produce, and deliver their communications. In low-consequence deception, deceivers use the same default cognitive mechanisms as truth tellers do to manage their messages (Anolli, Balconi & Ciceri, 2002). While deceivers' cognitive efforts may increase as deception becomes more complex or the consequences of discovery more serious, cognitive loading is not always indicative of deception. Some truth tellers experience increased cognitive loading when telling difficult truths as compared to simple lies, while Machiavellian deceivers find serious lies easier to manage than naive liars (Ashton, Lee & Son, 2000 as cited in Anolli, Balconi & Ciceri, 2002).

How is it then, that people are more successful at identifying truthful statements than lies? Is there something in the linguistic template of a truthful statement that distinguishes it from a lie? Levine et al. (1999) suggest that statements are more likely to be identified as truthful because people have a tendency to judge messages as truthful rather than deceptive (truth-biased). In certain contexts, such as in face-to-face communication or when addressees are not forewarned to expect deception, expectations of being told the truth and, consequently, the identification of truthful messages, are even higher (Buller, Strzyzewski & Hunsaker, 1991; McCornack & Parks, 1986, as cited in Levine et al. 2006).

Veracity base rates (the probability that a message within a given context is likely to be judged truthful, irrespective of whether it is truthful or not) appears to play a substantial part in predicting accuracy levels in identifying truthful statements, irrespective of deception cues (Levine et al. 2006). Accuracy in identifying truthful statements, therefore, appears to be based largely on individual expectations of truthfulness within a given context, and not on any linguistic strategy or information content that truth tellers might employ as distinct from deceivers. In fact, Park et al.'s (2002) study into how people detect lies reveals that less than 2% of their subjects recall detecting deception based on verbal and nonverbal cues alone at the time the lie is told. Most lies are in fact discovered at a later date through the provision of third party information and other physical evidence. In short, there does not appear to be a standard linguistic strategy for truth telling that people draw on to determine whether someone is lying.

However, what can be identified in this study is the way that truth tellers linguistically present themselves and structure their narrative when they were telling the truth, as distinct to when they are lying. In the Known Group 1 Statements at least, truth tellers use lower levels of *My* and MoDs, and their statements contain more words per episode and have less episode fragmentation compared to deceivers. In other words, truth tellers focus on themselves more as whole persons initiating the action, instead of having the action done to them or to bits of them, or referring to things in their possession. Their descriptions as to what happened are clearer and their narratives tend to be constructed in larger episode chunks, which suggest a more cohesively sequential story.

4.5. *Predicting Deception in the Blinded (Group 2) Statements*

The purpose of analysing the Known Statements was to identify and observe the behaviour of cues which differentiated between Truthful and Deceptive Statements, and then use those cues and behaviours to predict deception in the Blinded Statements. At this stage, the classification of the Blinded Statements remain unknown, and results will not be unblinded until these predictions (and the statistical predictions in the following chapter) are completed.

Predictions regarding the Blinded Statements are made using the linguistic strategies their authors have adopted. This analysis ignores cues in isolation, instead making use of cues in *combination*, *interaction*, and their *progression* indicative of deceptive strategies at play as identified earlier. Features such as clause length and narrative fragmentation are also taken into account in the analysis, providing a holistic approach to deception detection. For this reason, predictions on the basis of informed expert opinion are only made for whole Statements and are not extended to episode analysis.

Statement No.	Cat. T/D	Description
16	1	This Statement (arson – 6 episodes) covers a few hours. It has a strong collective focus with high use of *First Person Plural Pronoun* (45% of clauses) and within the normal range use of *First Person Singular Pronouns* (24%) and *MoDs* (17%). There is no unusual cue interaction characteristic of a deceptive linguistic strategy and no unusual change in linguistic profile of episodes. No deception strategy is identified.
17	2	This Statement (rape – 16 episodes) covers a few hours. *MoDs* (23%) use is on the edge of being high, with much clustering, particularly in Episodes 2, 3, 7 & 8. The Statement contains very high use of *First Person Singular Pronouns* (51%) largely due to very high use of *My* (15%) and high use of *Me* (14%). The progression of individual self references indicates a gradual replacement of *I* by *Me* and *My* in the assault episodes (5-10). *Me* is introduced in Episode 4 and disappears after Episode 7 (main assault episode); *My* is introduced in Episode 5 (start of assault) and disappears after Episode 12 (contiguous with assault and immediately after). Throughout the assault episodes, combined *Me* and *My* use exceed *I*, and *I* use is largely associated with *MoDs* (Verb Strings, Negation, and Cognitive Verbs). Between Episodes 7 & 11, the episodes are heavily fragmented, identifying thematic discontinuity in the narrative. The profile is consistent with a Prolix and Personal deception strategy.
18	2 Ep.4	This Statement (child abuse – 9 episodes) covers 4 days. Overall, there is low use of *First Person Pronouns* (14%) and *MoDs* (14%), and within the normal range use of *Third Person Pronouns* (29%). However, the linguistic profile of Episode 4 (Day 2) is materially different to that of the other episodes. The high use of *My* (14%) occurs in Episode 4 together with clustering of *MoDs*. The profile of Episode 4, as well as the distinct departure of Episode 4 from the profiles of the other episodes, indicates a Prolix and Personal deception strategy in use.
19	1	This Statement (child abuse – 17 episodes) covers an unknown period of months. Overall, its *MoDs* use (23%) is just within the normal range, with much clustering of cues and a high use of *Third Person Pronouns* (49%). However, there is no unusual *First Person Pronouns* cue interaction consistent with previously identified deceptive strategies and no unusual change in linguistic profile of episodes. No deception strategy is identified.
20	2	This Statement (rape – 14 episodes) covers one day. It makes high very use of *First Person Singular Pronouns* (54%) brought about by very high use of *Me* (19%) and high use of *My* (13%), the combined use of which exceeds *I* (26%). The Statement also contains the highest density of *MoDs* (34%) of all the Statements, and very high use of *Third Person Pronouns* (50%). This profile is consistent with a depersonalised deception strategy.

Statement No.	Cat. T/D	Description
21	1	This is a short Statement (murder/suicide – 6 episodes) covers less than an hour. It is fragmented (Episodes 1, 4 & 5), indicating a lack of cohesion between episodes. However, its use of *First Person Singular Pronouns* (21%) and *Third Person Pronouns* (21%) is within the normal range, and there is no unusual cue interaction characteristic of a deceptive linguistic strategy. No deception strategy is identified.
22	2	This is a short Statement (robbery – 7 episodes) covers several hours. It is fragmented (Episodes 1-6), indicating a lack of cohesion between episodes. *First Person Singular* Pronoun use is within the normal range (33%) but *Me* (12%) is high; combined *Me* and *My* (9%) use exceeds *I* (14%) which is low. The Statement becomes increasingly depersonalised as the episodes progress. *Me* first appears at Episode 5 (start of robbery) and *I* disappears from Episodes 6 & 7 (robbery episodes). *Me* disappears after the 1st line of Episode 7 (main robbery episode); thereafter, the author is present only as *My*. *Third Person Pronoun* use is normal (17%) although *other* references predominate; the author prefers to refer to others by name rather than use *Third Person Pronouns*. This profile is consistent with a depersonalised deception strategy.
23	2	This is a long Statement (kidnapping/rape – 28 episodes) covering two days. Overall, it has very high use of *First Person Singular Pronouns* (56%), with very high *I* (38%) and high *Me* (13%) use. There is a change in linguistic profile of episodes between Episodes 14-20, coinciding with the abduction and rape. Episode 14 sees a sudden hike in *I*, *My* & *MoDs*, and *I* is largely associated with *MoDs* in those episodes. From Episode 14 to 16, *I* use reduces while *Me* use increases; in Episode 19, *My* & *Me* use is 7 times that of *I*; *My* use disappears after Episode 19. From Episode 21 onwards (second half of rape/kidnap account), the linguistic profile of episodes returns to that seen before the start of the kidnap/rape account (Episodes 1-13). This profile is consistent with a Prolix and Personal deception strategy.
24	1	This Statement (bank robbery – 11 episodes) covers a few minutes. It makes very high use of *Third Person Pronouns* (50%) and low use of *I* (10%), indicating an *other* focus. However, there is no unusual cue interaction characteristic of a deceptive linguistic strategy. No deception strategy is identified.
25	2	This long Statement (assault – 14 episodes) covers a few minutes. It has long clauses (average 8 words/clause), within the normal range use of *MoDs* (23% - verging on the high end) and very high *First Person Singular Pronouns* (54%) driven up by very high use of *My* (26%). This profile is consistent with a Prolix and Personal deception strategy.
26	2	This Statement (murder – 15 episodes) covers several hours. It is highly fragmented between Episodes 3-10, indicating a lack of cohesion between episodes. It has high *MoDs* (27%), as well as very high *First Person Singular Pronouns* (52%) with very high *Me* (17%) and high *My* (10%). This profile is consistent with a Prolix and Personal deception strategy.

Statement No.	Cat. T/D	Description
27	B1	This short Statement (suicide – 6 episodes) covers several hours. It has high *MoDs* (27%), very high *I* (41%) and high *Me* (14% - on the edge of very high). This profile is consistent with a Prolix and Personal deception strategy; however, there is no clustering of *MoDs*. Uncertain of designation - probably truthful (as *MoDs* clustering is an integral part of the deceptive strategy).
28	1	This Statement (murder – 12 episodes) covers an evening. Its use of *MoDs* (21%) is within the normal range. There is no unusual cue interaction characteristic of a deceptive linguistic strategy. No deception strategy is identified.
29	2	This long Statement (rape/threatening behaviour – 37 episodes) covers an unknown period of several months. Its use of *MoDs* is within the normal range (23% - on the edge of high), very high *First Person Singular Pronouns* (52%) with high *I* (32%), very high *Me* (15%) and high *My* (10%). This profile is consistent with a Prolix and Personal deception strategy.
30	B2	This Statement (arson – 7 episodes) covers 3 days. Its use of *MoDs* is within the normal range (23% - on the edge of high) with much clustering, very high *First Person Singular Pronouns* (63%) with very high *I* (37%) and *Me* (15%), and high *My* (14% - on the edge of very high). Most of the *MoDs* use is contained in reported speech, so uncertain of designation, although believed deceptive.
31	2	This Statement (rape – 15 episodes) covers an evening. It makes very high use of *MoDs* (31%) with clustering, and high use of *First Person Singular Pronouns* (49%), with high *I* (33%) and *Me* (14% - on the edge of very high). Episode 8 (start of the rape – covered in Episodes 8-12) sees the first appearance of *My* (Episodes 8, 11 & 12), increase in *Me* (Episodes 8-11) and a sudden jump in *MoDs* clustering (Episodes 8, 10 & 11). This profile is consistent with a Prolix and Personal deception strategy.
32	B1	This Statement (sexual assault – 15 episodes) was written many months after the event, and covers an evening. It has very high use of *First Person Singular Pronouns* (50%) with very high *Me* (18%) and high *My* (10%). This profile is consistent with a Prolix and Personal deception strategy; however, *MoDs* (19%) use is within the normal range and there is no clustering. Uncertain of designation - probably truthful (as *MoDs* clustering is an integral part of the deceptive strategy).
33	1	This Statement reports rape (10 episodes) which takes place on two separate days. There is very high use of *First Person Singular Pronouns* (53%), driven up by very high use of *Me* (21%). However, *I* (21%) use is within the normal range and *MoDs* are low (13%). No deception strategy is identified.

Statement No.	Cat. T/D	Description
34	1	This long Statement (sexual assault - 97 episodes) covers many months. The actual day of the assault is covered in Episodes 41-97, the actual assault in Episodes 49-85. The Statement has within the normal range use of *MoDs* (23% - on the edge of high), high (43%) *First Person Singular Pronouns*, and within the normal range (9% - on the edge of high) use of *Me* and *My*. The author suffers Dissociative Identity Disorder (multiple personality) and this has influenced her language i.e. the actual assault is recounted by one of the author's personalities and not the author herself (almost complete absence of *I*), and high use of cognitive verbs is consistent with an internally generated memory. However, there is no unusual cue interaction characteristic of a deceptive linguistic strategy. No deception strategy is identified.
35	1	This Statement (child abuse – 10 episodes) covers two days. It makes use of very high *Third Person Pronouns* (58%). *MoDs* are low (15%) as is *First Person Singular Pronouns* (20%). No deception strategy is identified.
36	2	This Statement (child abuse – 4 episodes) covers several hours. It has within the normal range use of *MoDs* (20%) and on the lower-side-of-normal (23%) *First Person Singular Pronouns*; there is no use of *Me* or *My*. It has very high *Third Person Pronouns* (70%) and short clauses (4.8 words/clause). The Statement has a strong *other* focus. Consistent with a depersonalised strategy.
37	1	This Statement (child abuse – 11 episodes) covers four days. It's use of *First Person Singular Pronouns* (32%), individual self-references and *MoDs* is within the normal range, although *Third Person Pronouns* (41%) is high. However, there is no unusual cue interaction characteristic of a deceptive linguistic strategy. No deception strategy is identified.
38	1	This Statement (robbery – 3 episodes) covers less than an hour. It makes high use of *First Person Singular Pronouns* (39%), *I* (26%) and *Me* (13%) but MoDs (16%) are on the low edge of the normal range. No deception strategy is identified.
39	1	This Statement (murder – 2 episodes) recounts a conversation. It has high use of *First Person Singular Pronouns* (40%) and *I* (36%) but within the normal range use (1%) of *Me* and *My.* No deception strategy is identified.
40	1	This Statement (murder – 7 episodes) covers an evening. All features are within the normal range. No deception strategy is identified.

Figure 75: Predictions for Blinded (Group 2) Statements

In the table above (Figure 75), each blinded Statement is numbered, labelled, and the principal cues which form the basis of the prediction are described. A 4-way category has been devised to label Statement categories based on the level of certainty of the prediction: *Truthful*, *Deceptive*, *Believed Truthful*, and *Believed Deceptive*.

Statements are labelled *Deceptive* (2) on the basis that the presence of cues and their interaction with other cues are indicative of a deceptive strategy at work as previously identified (see Section 4.4); Statements are labelled *Truthful* (1) if the cue interactions required to identify a deceptive linguistic strategy are absent. No attempt is made to identify truthfulness; the category is predicted purely on absence of deception cues and not because there is no deception. Where a prediction is uncertain, the Statement is labelled with its '*Believed'* category accompanied by a *B*. Therefore, where a Statement is believed to be T*ruthful* or *Deceptive*, but that prediction is of a lower certainty, the Statements is labelled *B1* or *B2*. Where deception in a particular episode is suspected, the episode number is provided alongside the 1 or 2 designation, or is mentioned in the description. All percentages in the 'Description' refer to clause density.

On the basis of overall cue strengths, the interaction of those cues, and linguistic profiles identified through episode analysis, it is predicted that:

- Statement nos. 17, 18, 20, 22, 23, 25, 26, 29, 31 & 36 are *Deceptive* (2);
- Statement nos. 16, 19, 21, 24, 28, 33, 34, 35, 37, 38, 39 & 40 are *Truthful* (1);
- Statement nos. 27 and 32 are believed *Truthful* (B1); Statement no. 30 is believed *Deceptive* (B2).

At this stage, the results remain blinded further to additional analysis and predictions using statistical analysis in the following chapter. However, these categories become important at the point of unblinding (Chapter 6) as they also reflect the law enforcement source levels of certainty regarding the categorisation of Statements.

4.6. *Conclusion*

The qualitative and descriptive analysis of the Known Statements resulted in some surprising revelations. Having found that deceivers use more words than truth tellers, evidence from episode analysis of the Known Statements reveals that truthful portions of Deceptive Statements tend to have longer clauses than the deceptive portions. However, most Deceptive Statements devote the majority of their narratives to the deception.

Individually, a general trend is found for an association between Vague Pronoun References, Verb Strings, Negation, Cognitive Verbs and deception; collectively (using the MoDs combined cues), the association is much stronger and the density of collective cues is a strong discriminator between Truthful and Deceptive Statements. Cues do not all have the same weighting and their strength as deception predictors varies, with Verb Strings and Cognitive Verbs being stronger indicators at the episode level, and Vague Pronoun References and Negation at the whole-statement level. In other words, deceivers appear to use more Verb Strings and Cognitive Verbs in the immediate area of deception, while Vague Pronoun References and Negation occur even in the truthful language of Deceptive Statements.

This voyage of discovery carries on into Pronoun analysis. No correlation is found between truth telling and First Person Pronouns. On the contrary, Deceptive Statements contain slightly more self-reference clauses than truth tellers. This association arises out of the increased use of *Me* and, particularly, *My* by deceivers. This is the first time that self-references have been analysed individually and these findings suggest that *I*, *Me*, and *My* should no longer be grouped together when analysing for deception.

Increased Third Person Pronoun use is associated with truth tellers, contradicting most previous literature. However, when one considers the context of the Statements, it makes sense that truthful witnesses will refer to the behaviour of others more often if they have no reason to believe they may be suspected of a crime and have to justify their own behaviour. These results suggest that the immediacy and distancing signalled by pronouns are influenced by context, and explains the role reversals of First Person Singular and Third Person Pronouns.

Deceivers and truth tellers also construct their narratives differently. Deceptive narratives tend to fragment into shorter episodes, probably indicating a lack of cohesion. This may be because the stories are not anchored in real time, coupled with the increased cognitive load of putting together a false reality (either completely imagined, or selectively picking real events and pasting them on to a false timeline).

A number of associations and interactions between cues, which were more likely to be found among Deceptive than Truthful Statements, are also identified. These suggest a deceptive linguistic strategy at work, of which two main strategies are identified: *Prolix and Personal* – described as immediate yet ambiguous, verbose, and with high use of self-references; and *Impersonal* – described as non-immediate, direct, and with selective use of self-references. In some Statements, these associations are apparent when measuring overall the overall density of cues; in others, they are more subtle, being identified only at the episode level through analysis of linguistic progression.

These cue interactions are used in a structured approach to predict the categories of the blinded Statements, resulting in 10 Statements predicted to be *Deceptive* and 12 Statements predicted to be *Truthful*; another 3 Statements have lower certainties of predictions, with 2 Statements *Believed Truthful*, and 1 Statement *Believed Deceptive*.

At this stage, the results remain blinded further to additional analysis and predictions using statistical analysis in the following chapter.

CHAPTER 5

5. Statistical Analysis of Known (Group 1) and Blinded (Group 2) Statements

Having performed qualitative and descriptive analysis on the Known and Blinded Statements, quantitative analysis in the form of statistical testing of the data was undertaken to explore several question.

First, is there a significant difference between linguistic cues found in the Truthful and Deceptive Statements; second, how strongly are the cues associated with Deceptive Statements; third, is there a significant difference between cues found in Truthful and Deceptive episodes within the same statement; and fourth, can deception be predicted on the basis of the presence of certain cues or combination of cues?

The analysis design involves using various statistical tests in order to 1) test the difference between Means for Significance (Independent One Sample T-Test); 2) measure the strength of association between variables (Pearson Correlation), and 3) predict category membership (Discriminant Function Analysis & Binary Logistic Regression).

5.1. *Nature of Data*

The quantitative data involves scale measurements of 11 cues found in the combined 40 Known and Blinded statements. These were analysed according to word and clause count (the occurrence of cues in relation to the total number of words or clauses in the Statement).

Word count analysis was previously used by Pennebaker, Francis & Booth (2001) in their research to identify the mental health of authors of statements on the basis of their word choice. Previous studies into deceptive communication have used a variety of measurements such as total number of words (Anolli & Ciceri, 1997; Anolli, Balconi & Ciceri, 2003; Newman et al. 2003; Zhou et al. 2004a; Zhou & Zhang, 2004) and number of words in a sentence (Zhou et al. 2004b), while others have used combinations of features such as word syllables, words and number of sentences (Burgoon et al. 2003) or words, verbs and number of sentences (Qin et al. 2005).

In addition to word count, it was also decided to analyse variables on a clause basis to mitigate against irregular text length. To my knowledge, no one has used clause length as a unit of measurement. Using clause measurement overcomes difficulties in identifying sentence length due to poor grammar or the absence of punctuation, without losing meaning. For the purpose of this study, a clause is defined as having a subject (present or implied) and a predicate (with other elements which complete the predicate). Described as *the device of relevance* (Winter, 1994), clauses are powerful units of communication and the smallest unit of meaning in a sentence. The lexical choices that go into clause construction are selected by authors for their perceived relevance to the message. In written witness statements, where every unit of information and the sequence of that information should be viewed as important, clause construction is vital to understanding the overall communication.

The data for statistical testing consists of:

- the test group of 15 Known Statements, of which 5 Statements contain truthful accounts and 10 Statements whose accounts are entirely or partially deceptive, nominally classified into *Truthful* (1) and *Deceptive* (2); and
- the 25 Blinded Statements whose categories (*Truthful* or *Deceptive*) are unknown (to everyone except the law enforcement sources of the Statements).

To summarise the data, all Statements are hand-written (except for 1 word-processed Statement) by their authors, narrating an event (serious crime) in which the authors were involved, either as perpetrators of the criminal activity, victims, or as witnesses to the event. The authors of the Known Statements are US American native-English speakers from diverse social and educational backgrounds, ranging in age from late teens to mid-50s. Details of the Blinded Statement authors are unknown other than they are US American native-English speakers. Thirty-eight Statements were written within a week of the events reported; 1 Statement refers to an event which occurred more than 6 months previously, and 2 Statements cover events which span a number of months (period unknown).

5.1.1. Linguistic Variables

On the basis of the Known Statements' qualitative analysis, 11 cues were analysed:

1. *MoDs* (combined cue set which includes the cues*)
2. *I*
3. *Me*
4. *My*
5. *First Person Singular Pronouns*
6. *Third Person Pronouns*
7. *Vague Pronoun References**
8. *Verb Strings**
9. *Cognitive Verbs**
10. *Negation**
11. *Clause Length*

Cues 2-10 were selected on the basis of previous studies into deception detection, a discussion of which can be found in Chapters 1 and 2. Cue 5 (*First Person Singular Pronouns*) is the collective use of Variables 2 (*I*), 3 (*Me*), and 4 (*My*), as well as *Myself* and *Mine*. Newman et al. (2003) suggest that there might be a case for different weighting to be attributed to *I* and *Me* when considering distancing by authors towards the subject of their communication, as the former refers to the author as the agent, and the latter as the recipient of the action. For this reason, *I*, *Me* and *My* are analysed individually as well. Variable 1 (*MoDs*), the collective cue set made up of *Vague References*, *Verb Strings*, *Cognition Verbs* and *Negation* is included on the basis of previous findings that multiple cues are better for identifying deception (Vrij, 2000; DePaulo et al. 2003) than a single cue on its own. Variable 11, *Clause Length*, is the only variable not previously tested in the literature and replaces sentence length as a measurement of information content and verbosity.

The Known Statements were analysed first. As category memberships of the individual Statements are already known, the results of their linguistic variable tests were used to predict membership of the Truthful or Deceptive categories in Blinded Statements.

5.1.2. Means and Standard Deviation

The Means and Standard Deviations of variables from the Truthful (5 Statements = T (5)) and Deceptive (10 Statements = D (10)) categories of the Known (Group 1) Statements were analysed (along with all other following statistical analyses) using SPSS 15 statistical software.

The results are expressed in terms of the mean percentage of variables in relation to the total text word count. For example, *My* constitutes on average 1.12% of the total word count per Statement in the Truthful category, while averaging 2.45% of the total word count per Statement in the Deceptive category (Figure 76).

Variables	Mean T (5)	Standard Deviation	Mean D (10)	Standard Deviation	Mean (15)	Standard Deviation
MoDs*	2.48	1.23	4.36	1.56	3.73	1.68
I	6.20	1.42	4.79	1.55	5.26	1.61
Me	1.00	1.04	1.31	1.02	1.21	1.00
My	1.12	0.96	2.45	1.16	2.01	1.24
First Person Singular Pronoun	8.30	1.97	8.61	2.45	8.51	2.23
Third Person Pronouns	7.12	3.74	4.37	3.69	5.29	3.81
Vague Pronoun References*	0.14	0.19	0.67	0.69	.49	.62
Verb Strings*	0.90	1.11	1.38	0.54	1.22	.77
Cognitive Verbs*	0.62	0.48	1.03	0.58	.89	.57
Negation*	0.68	1.13	1.10	0.68	.96	.84

Figure 76: Known Statements - Means & Standard Deviation (Word)

The same analysis was carried out on the Known Statements on a clause basis. The results are expressed in terms of mean percentage of clauses containing the variable in relation to the total clause count of the Statement. For example, *My* appears in 5.54% of clauses in the Truthful category and in 14.4% of clauses in the Deceptive category (Figure 77).

Variables	Mean T (5)	Standard Deviation	Mean D (10)	Standard Deviation	Mean (15)	Standard Deviation
MoDs*	11.6	5.24	21.71	6.05	18.34	7.47
I	30.82	6.40	29.86	8.90	30.18	7.93
Me	4.94	5.24	7.73	5.68	6.80	5.52
My	5.54	4.65	14.4	4.75	11.45	6.28
First Person Singular Pronoun	39.74	7.65	46.02	12.27	43.93	11.09
Third Person Pronouns	31.66	14.66	23.45	17.00	26.19	16.23
Vague Pronoun References*	0.54	0.76	4.08	4.38	2.90	3.93
Verb Strings*	4.66	5.65	8.28	3.13	7.07	4.30
Cognitive Verbs*	3.88	2.71	6.38	3.83	5.55	3.60
Negation*	3.38	5.30	6.70	4.00	5.59	4.57
Clause Length	5.02	0.40	6.60	0.87	6.07	1.06

Figure 77: Known Statements - Means & Standard Deviation (Clause)

The *Clause Length* variable is calculated differently, with the results expressing the mean average number of words per clause. Therefore, clauses in the Truthful category (5 Statements with 314 clauses in total) average 5 words per clause, while those in the Deceptive category (10 Statements with 651 clauses in total) average 7 words per clause.

5.1.3. Independent Sample T-Test

The sampling distribution of the difference between means of linguistic variables (for word and clause count) in the Known Statements was tested next. The data was checked for outliers and extreme values using the Descriptive Statistics function of SPSS 15.

Outliers are defined as values being more than 1.5 times the interquartile range above the upper quartile or below the lower quartile, while extreme values are defined as values being more than three times the interquartile range above the upper quartile or below the lower quartile (Kinnear & Grey, 2008). These were identified in both word and clause analysis and the Statements deselected before running the Independent Sample T-Test.

Ten variables (excluding clause length) were tested using word count, and unequal variances taken into account where required.

5.1.4. Word Analysis

As described above, cases identified as being outliers in the analysis of relevant variables are described below as being excluded from the analysis.

Three variables are significant at the .05 level.

- The scores of *MoDs* in the Deceptive group (M = 4.03; SD = 0.51) are significantly different from those of the Truthful group (M = 2.48; SD = 1.23): t(5) = 2.65; p = .05 (two-tailed) after three cases are excluded from the analysis. Cohen's *d* = 1.64, a large effect. There is not equality of variance in this case, with appropriate values being used.
- The scores of *My* in the Deceptive group (M = 2.45; SD = 1.16) are significantly different from those of the Truthful group (M = 0.72; SD = 0.43): t(12) = 2.84; p = .02 (two-tailed) after one case is excluded from the analysis. Cohen's *d* = 1.97, a large effect.
- The scores of *Negation* in the Deceptive group (M = 0.96; SD = 0.53) are significantly different from those of the Truthful group (M = 0.20; SD = 0.40): t(11) = 2.54; p = .03 (two-tailed) after two cases are excluded from the analysis. Cohen's *d* = 1.61, a large effect.

5.1.5. Clause Analysis

Eleven variables were tested using clause counts, and unequal variances taken into account where required. As described above, cases identified as being outliers in the analysis of relevant variables are described below as being excluded from the analysis. Five variables are found to be significant at the .01 and .05 level.

Three variables are significant at the .01 level.

- The scores of *MoDs* in the Deceptive group (M = 21.71; SD = 6.05) are significantly different from those of the Truthful group (M = 11.6; SD = 5.24): t(13) = 3.17; p = .007 (two-tailed). Cohen's *d* = 1.79, a large effect.
- The scores of *My* in the Deceptive group (M = 13.31; SD = 3.48) are significantly different from those of the Truthful group (M = 3.60; SD = 1.93): t(11) = 5.16; p = .0003 (two-tailed) after two cases are excluded from the analysis. Cohen's *d* = 3.45, a large effect.
- The scores of *Clause Length* in the Deceptive group (M = 6.60; SD = 0.87) are significantly different from those of the Truthful group (M = 5.02; SD = 0.40): t(13) = 3.82; p = .0004 (two-tailed). Cohen's *d* = 2.34, a large effect. There is not equality of variance in this case, with appropriate values being used.

Two variables are significant at the .05 level.

- The scores of *Vague Pronoun References* in the Deceptive group (M = 4.08; SD = 4.38) are significantly different from those of the Truthful group (M = 0.54; SD = 0.76): t(10) = 2.48; p = .03 (two-tailed). Cohen's *d* = 1.13, a large effect. There is not equality of variance in this case, with appropriate values being used.
- The scores of *Negation* in the Deceptive group (M = 6.70; SD = 3.99) are significantly different from those of the Truthful group (M = 1.20; SD = 2.40): t(12) = 2.54; p = .03 (two-tailed) after one case is excluded from the analysis. Cohen's *d* = 1.67, a large effect.

These analyses identify clause count as being a more productive discriminator than word count between the Truthful and Deceptive categories. For this reason, only clause count variables were extended into Discriminant Analysis.

For Discriminant Analysis to be successful, certain conditions need to be met by the data, namely that variables are normally distributed (Goodness-of-Fit), variances are roughly similar (Homogeneity of Variance), and sample text sizes are roughly similar.

As the Statement population cannot be controlled for length, it is necessary to meet the requirements for Normality and Homogeneity of Variance. Accordingly, Goodness-of-Fit is tested using the One Sample Kolmogorov-Smirnov Test, and homogeneity of variance using Levene's Test.

5.1.6. One Sample Kolmogorov-Smirnov Test

All the variables in Known Statements were tested for Goodness-of-Fit. This test for normality compares whether the actual distribution of variables conforms to the expected (hypothetical) distribution in that particular type of sample.

The One Sample Kolmogorov-Smirnov test (Figure 78) provides no evidence against the null hypothesis, implying that the samples have been drawn from a normal population. The distributions of variables are found to be non-significant, indicating that they are within normal parameters.

Variables	K-S Z	D (two-tailed)	Exact Sig.
MoDs	.608	.157	.801
I	.567	.146	.859
Me	.638	.165	.752
My	.454	.117	.971
First Person Singular Pronoun	.811	.209	.465
Third Person Pronouns	.380	.098	.996
Vague Pronoun References	1.162	.300	.108
Verb Strings	.563	.145	.865
Cognitive Verbs	.481	.125	.952
Negation	.604	.156	.806
Clause Length	.809	.209	.467

Figure 78: Known Statements - One Sample K-S Test (Clause Analysis)

5.1.7. Levene's Test for Homogeneity of Variance

All variables in the Known Statements were then tested for homogeneity of variance. This tests how spread out the distribution of a variable is within a population and whether this distribution is equal (Figure 79).

Two variables, Vague Pronoun References and Clause Length (.023 and .033 respectively) show significantly different variance across the group. Consequently, these variables are dropped from Discriminant Analysis.

Although clause length cannot be used in Discriminant Analysis, it is interesting to note that Pearson Correlation analysis identifies a strong correlation between Category and Clause Length $r(15) = .727$; $p < .01$. $r^2 = 0.53$, where Deceptive Statements contain longer clauses.

Variables	F	Sig.
MoDs	.002	.965
I	.038	.849
Me	.121	.734
My	.042	.841
First Person Singular Pronoun	.881	.365
Third Person Pronouns	.322	.580
Vague Pronoun References	6.587	.023
Verb Strings	2.368	.148
Cognitive Verbs	1.192	.295
Negation	.537	.477
Clause Length	5.718	.033

Figure 79: Known Statements - Levene's Test for Homogeneity of Variance

5.1.8. Discriminant Function Analysis

Discriminant Function Analysis is used to determine whether any of the variables identified can successfully discriminate between Truthful and Deceptive Statements and, if so, which variable is the most successful discriminator. This information is then used to predict category membership in the Blinded Statements.

5.1.9. Wilks' Lambda

This multi-variable measure of group Means shows that variables in combination successfully discriminate between Truthful and Deceptive Statements in the Known Statements (Wilks' $\lambda = 0.28$, $\chi^2_{(2)} = 15.22$, $p < 0.0001$).

Variables	$F_{(1,13)}$	Sig.
My*	11.62	.005*
MoDs*	10.15	.007*
Verb Strings	2.63	0.13
Negation	1.87	0.19
Cognition Verbs	1.68	0.22
Total 1st Person S	1.04	0.32
Total 3rd Person	0.84	0.37
Me	0.84	0.38
I	0.07	0.80

Figure 80: Known Statements - F-ratios (Equality of Group Means)

Ranking the F-ratios identifies the occurrence of *My* as the best single discriminator, with MoDs as a close second (Figures 80 and 81).

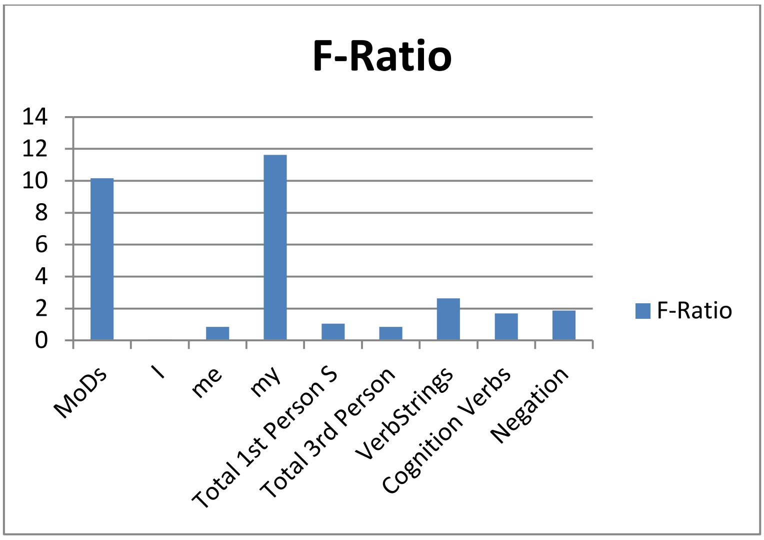


Figure 81: Known Statements - F-Ratio Graph

Strictly, this combination of variables is non-independent as MoDs are a combination of 3 other variables also tested (Verb Strings, Cognition Verbs and Negation), and First Person Singular Pronouns includes 3 other variables also tested: *I*, *Me*, and *My*. Consequently, a second analysis was carried out excluding MoDs and First Person Singular Pronouns. This second analysis shows that the variables in combination (*I, Me, My,* Third Person Pronouns, Verb Strings, Cognitive Verbs and Negation) still successfully discriminate between the Known (Group 1) Truthful and Deceptive Statements (Wilks' $\lambda = 0.37$, $\chi^2_{(2)} = 11.90$, $p = 0.003$).

5.2 Post Hoc Discriminant Function Analysis

Two Discriminant Function Analyses were carried out on the Group 1 Statements: first, using the 9 variables (*MoDs*, *I, Me, My,* First Person Singular Pronouns, Third Person Pronouns, Verb Strings, Cognitive Verbs and Negation); second, the same variables but excluding MoDs and First Person Singular Pronouns.

The variables Vague Pronoun References and Clause Length were omitted from both analyses as they do not satisfy the requirement for Homogeneity of Variance. MoDs and First Person Singular Pronouns were omitted as well in the second analysis as they collectively represent individual variables already being used in the analysis and results might be skewed by counting those variables twice.

5.2.1. First Discriminant Function Analysis (*post hoc* - 9 variables)

The Discriminant Function Analysis model using 9 variables successfully classified *post hoc* 93.3% of Truthful and Deceptive category texts from the Known Statements, correctly classifying 90% of Deceptive Statement and 100% of Truthful Statements. One Statement (no. 15) was misclassified as Truthful (Figure 82).

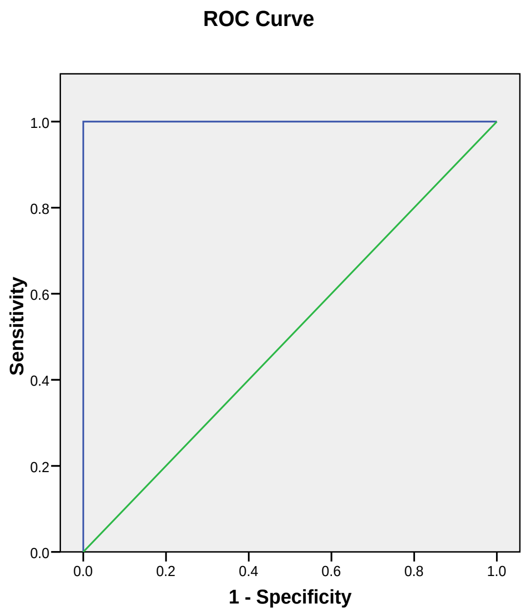
Cross-validation was equally successful with this small group, with the leave-one-out classification method also seeing 93.3% of Statements correctly classified, although with a substantially lower certainty of classification than the full model. In both the full and cross-validated model, the same Statement (no. 15) was misclassified as *Truthful*, with the certainty of misclassification in the cross-validated model substantially lower than in the full model.

		Full Model		Cross-Validated Model	
Statement No.	**Actual Group**	**Predicted Group**	**P(D>d│G=g)**	**Predicted Group**	**P(D>d│G=g)**
1	1	1	.370	1	.202
2	1	1	.468	1	.008
3	1	1	.940	1	.000
4	1	1	.870	1	.000
5	1	1	.945	1	.958
6	2	2	.161	2	.065
7	2	2	.851	2	.001
8	2	2	.539	2	.000
9	2	2	.664	2	.000
10	2	2	.949	2	.282
11	2	2	.695	2	.033
12	2	2	.755	2	.059
13	2	2	.274	2	.000
14	2	2	.056	2	.000
15	2	1*	.245	1*	.036

Figure 82: Known Statements - Discriminant Function Analysis (9 variables)

The accuracy of Discriminant Analysis (how well it classified Truthful and Deceptive Statements) was analysed using a ROC (Receiver Operating Characteristic) Curve. ROC Curves plot *sensitivity* (identification of true-positives) against *specificity* (identification of false-positives rate), with the discrimination accuracy being measured as the area under the curve. Points on the curve represent decision thresholds where sensitivity/specificity values for that threshold are calculated.

Using 9 variables (MoDs, *I, Me, My,* First Person Singular Pronouns, Third Person Pronouns, Verb Strings, Cognitive Verbs and Negation) to classify Deceptive Statements, the area under the ROC Curve is 1.000 (100%) (Figure 83). The optimal cut-off value for the probabilities of membership in the Deceptive category is .235, which represents a sensitivity of 1.000 (100%) with a 0.00 (0%) false positive rate (1 – Specificity). This indicates that the variables are successful in correctly categorising statements in the Known Statements as Deceptive 100% of the time, with no false positives.



Area	Std. Error	Asymptotic Sig.	95% LCL	95% UCL
1.00	.000	.002	1.000	1.000

Figure 83: Known Statements - ROC Curve Results (9 variables)

The optimal cut-off value for the probability of membership in the Truthful category is .765, which represents a sensitivity of 1.000 (100%) with a 0.00 (0%) false positive rate (1 – Specificity).

This success rate suggests there may be overfitting as a result of too small a training data set. It may be that while the cues are very well suited for the small sample set, they may not generalise to a larger set (i.e. the Blinded Statements).

5.2.2. Second Discriminant Function Analysis (*post hoc* - 7 variables)

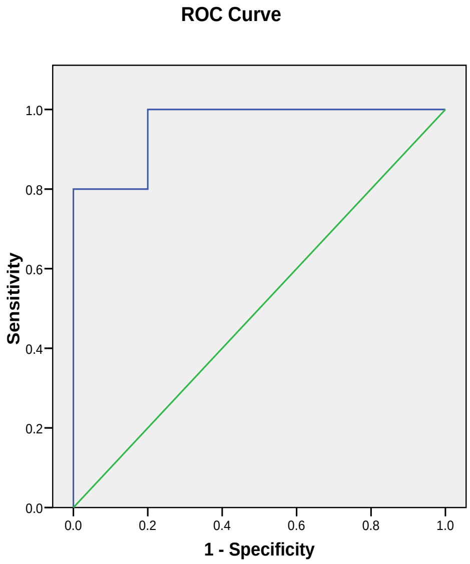
Discriminant Function Analysis was repeated, this time using only 7 variables (dropping MoDs and First Person Singular Pronouns) in order to test the independent variables. Wilks' Lambda shows that the 7 variables in combination successfully discriminate between Truthful and Deceptive Statements in the Known Group (Wilks' $\lambda = 0.37$, $\chi^2_{(2)} = 11.90$, $p = 0.003$)**.** This DFA Model also successfully classified *post hoc* 93.3% of the Known Statements (Figure 84). However, cross-validation was less successful, with the leave-one-out classification method seeing 80% of Statements correctly classified.

One Statement (no. 3) was misclassified in the full model; the same Statement was identified as misclassified in the cross-validated model, as well as two additional Statements (nos. 2 and 15). In two Statements (nos. 2 and 3), the certainty of classification in the cross-validated model is substantially lower than in the full model. However, the certainty of classification of misclassified Statement no. 15 in the cross-validated model is twice that in the full model.

		Full Model		Cross-Validated Model	
Statement No.	**Actual Group**	**Predicted Group**	**P(D>d│G=g)**	**Predicted Group**	**P(D>d│G=g)**
1	1	1	.385	1	.285
2	1	1	.417	2*	.079
3	1	2*	.237	2*	.087
4	1	1	.273	1	.374
5	1	1	.814	1	.787
6	2	2	.840	2	.944
7	2	2	.286	2	.451
8	2	2	.809	2	.727
9	2	2	.905	2	.259
10	2	2	.615	2	.415
11	2	2	.859	2	.980
12	2	2	.901	2	.990
13	2	2	.184	2	.252
14	2	2	.076	2	.015
15	2	2	.164	1*	.331

Figure 84: Known Statements - Discriminant Function Analysis (7 variables)

In the second Discriminant Analysis using the seven variables, the area under the ROC Curve was .960 (96%), the optimal cut-off value for the probabilities of membership in the Deceptive category being .830, representing a sensitivity of 0.800 (80%) with a 0.000 (0%) false alarm rate (1 – Specificity) (Figure 85). Thus, the probability of a Known (Group 1) Statement being correctly identified as Deceptive using the seven variables is 80%, with no false positives.



Area	Std. Error	Asymptotic Sig.	95% LCL	95% UCL
.960	.049	.005	.863	1.057

Figure 85: Known Statements - ROC Curve Results (7 variables)

The optimal cut-off value for the probabilities of membership in the Truthful category is .513, representing a sensitivity of 0.800 (80%) with a 0.00 (0%) false alarm rate (1 – Specificity).

5.3. A Priori Discriminant Function Analysis

Discriminant Function Analysis was re-run using the same discriminant model to predict *a priori* the Blinded Statement categories. The Blinded texts consist of 25 Statements which were supplied by a law-enforcement source without identifying the Statements' actual Truthful or Deceptive categories.

Only one *a priori* prediction analysis was carried out on the Blinded Statements using the same 7 independent variables (*I, Me, My,* Third Person Pronouns, Verb Strings, Cognitive Verbs and Negation) measured on a clause basis as the second *post hoc* Discriminant Function Analysis. The analysis resulted in 15 Statements (nos. 16, 18, 19, 21-24, 28, 34-40) being categorised as Truthful, and 10 Statements (nos. 17, 20, 25-27, 29-33) categorised as Deceptive (Figure 86).

Statement No.	Predicted Group	P(D>d | G=g)
16	1	.143
17	2	.409
18	1	.958
19	1	.889
20	2	.752
21	1	.241
22	1	.718
23	1	.449
24	1	.652
25	2	.003
26	2	.520
27	2	.362
28	1	.896
29	2	.885
30	2	.523
31	2	.971
32	2	.442
33	2	.376
34	1	.209
35	1	.767
36	1	.724
37	1	.220
38	1	.107
39	1	.404
40	1	.501

Figure 86: Blinded Statements - Discriminant Function Analysis (7 variables)

5.4. Statistical Analysis of Episodes

As well as statistically analysing the Known Statements on a whole-statement level, the texts were also analysed on an episode level, with each episode treated as an individual statement. This attempts to correct problems with overfitting given the small numbers of the Known Statements test group.

The 15 Statements making up the Known Group comprised 110 individual episodes. Of those 110 episodes, 55 were classified as *Truthful*, and another 55 classified as *Deceptive*. This similarity in the number of episodes in the two categories was only identified at the start of the statistical analysis after the individual episodes had been tagged, and is not artificially contrived to even up the numbers.

A number of limitations not present on the whole statement level apply to episode analysis:

- Episode length – these differ considerably more than with whole statements, with some episodes being only one clause long (short episodes being ≤ 25 words), while others are over 30 clauses long (≥170 words).

- Short Episodes (≤25 words) – do not lend themselves to productive analysis as the presence of a single linguistic cue produces artificially high results because of the low number of words in the episode.
- Category Uncertainty – there is no way of knowing (given their limited information content) whether some episodes are Deceptive or Truthful. This is particularly difficult with shorter episodes. Episodes were marked Truthful as long as their content was considered truthful, even though the information was suspect and they were within a known deceptive context.

Given these limitations, the treatment of individual episodes as if they are whole statements was conducted partly to create a semblance of a larger body of texts (given the limited number of Statements overall), and partly to discover whether linguistic features that appear to identify deception on a whole-statement level operate equally well at the episode level.

The same eleven variables (MoDs*, I, Me, My,* First Person Singular Pronouns, Third Person Pronouns, Vague Pronoun References, Verb Strings, Cognitive Verbs, Negation and Clause Length) were analysed on a clause and word basis, with word analysis excluding the *Clause Length* measurement.

5.4.1. Linguistic Variables

The Means and Standard Deviation of variables from the Truthful (55 episodes = T (55)) and Deceptive (55 episodes = D (55)) categories of Known Statements were analysed.

The results are expressed in terms of the mean percentage of variables in relation to the total episode word count (Figure 87). For example, *Me* constitutes on average 0.68% of total word count of Truthful episodes, while averaging 1.91% of total word count of Deceptive episodes.

Variables (Word Analysis)	Mean T (55)	Standard Deviation	Mean D (55)	Standard Deviation	Mean (110)	Standard Deviation
MoDs	3.12	6.42	4.35	3.32	3.74	5.12
I	5.63	4.14	5.27	5.74	5.45	4.99
Me	0.68	1.66	1.91	3.48	1.29	2.78
My	2.05	3.68	2.80	3.36	2.43	3.53
First Person Singular Pronouns	8.39	6.33	9.47	5.25	8.93	5.82
Third Person Pronouns	3.97	9.45	4.99	5.71	4.48	7.79
Vague Pronoun References	0.70	3.29	0.88	1.95	.79	2.69
Verb Strings	1.07	3.16	2.01	4.76	1.54	4.05
Cognition Verbs	0.73	1.83	1.05	1.67	0.89	1.75
Negation	0.65	1.33	1.52	5.76	1.08	3.51

Figure 87: Known Statements - Means and Standard Deviation of Episodes (Word)

The same analysis was carried out on the Known episodes on a clause basis. The results are expressed in terms of mean percentage of clauses containing the variable in relation to the total clause count of the episode (Figure 88). For example, *I* appears in 35.07% of clauses in Truthful episodes, and in 27.55% of clauses in Deceptive episodes.

Variables (Clause Analysis)	Mean T (55)	Standard Deviation	Mean D (55)	Standard Deviation	Mean (110)	Standard Deviation
MoDs	12.98	23.42	22.29	16.53	18.14	20.60
I	35.07	27.02	27.55	22.82	31.31	25.18
Me	4.84	14.97	10.49	19.90	7.67	16.67
My	12.81	23.53	18.78	25.63	15.79	24.68
First Person Singular Pronouns	42.73	30.19	52.58	25.91	47.66	28.43
Third Person Pronouns	15.14	20.04	25.59	26.14	20.36	23.77
Vague Pronoun References	3.04	14.97	4.97	10.54	4.01	12.92
Verb Strings	6.96	19.87	9.06	12.89	8.01	16.70
Cognition Verbs	5.54	16.38	6.22	9.58	5.88	13.36
Negation	4.06	8.97	5.41	9.03	4.73	8.98
Clause Length	6.50	2.43	6.30	1.77	6.40	21.21

Figure 88: Known Statements - Means and Standard Deviation of Episodes (Clause)

The *Clause Length* variable is calculated differently, with results expressing the mean average number of words per clause. Therefore, clauses in the Truthful category (55 episodes with 515 clauses in total) average 5 words per clause, while those in the Deceptive category (55 episodes with 450 clauses in total) average 7 words per clause.

5.4.2. Independent Sample T-Test

The sampling distribution of the difference between Means of linguistic variables for word and clause counts in the Known episodes was tested next.

The data was checked for outlier and extreme values using the Descriptive Statistics function of SPSS 15. Outliers are defined as values being more than 1.5 times the interquartile range above the upper quartile or below the lower quartile; extreme values are defined as values being more than 3 times the interquartile range above the upper quartile or below the lower quartile (Kinnear & Grey, 2008). These were identified in both word and clause analysis and the episodes deselected before running the Independent Sample T-Test.

5.4.3. Episode Word Count Analysis

Ten variables (excluding *Clause Length*) were tested using word count, and unequal variances taken into account where required. With extreme values removed, eight variables are significant at the .01 and .05 level.

Seven variables are significant at the .01 level.

- The scores of *MoDs* in the Deceptive group (M = 4.35; SD = 3.32) are significantly different from those of the Truthful group (M = 1.87; SD = 2.70): t(105) = 4.22; p = <.01 (two-tailed) after three episodes are excluded from the analysis. Cohen's *d* = 0.82, a large effect.
- The scores of *Me* in the Deceptive group (M = 1.28; SD = 1.97) are significantly different from those of the Truthful group (M = 0.08; SD = 0.35): t(54) = 4.31; p = <.01 (two-tailed) after fourteen episodes are excluded from the analysis. Cohen's *d* = 0.85, a large effect. There is not equality of variance in this case, with appropriate values being used.
- The scores of *My* in the Deceptive group (M = 2.43; SD = 2.78) are significantly different from those of the Truthful group (M = 1.21; SD = 1.87): t(91) = 4.31; p = .010 (two-tailed) after six episodes are excluded from the analysis. Cohen's *d* = 0.51, a medium effect. There is not equality of variance in this case, with appropriate values being used.
- The scores of *Third Person Pronouns* in the Deceptive group (M = 4.67; SD = 5.25) are significantly different from those of the Truthful group (M = 2.17; SD = 2.88): t(83) = 3.04; p = .003 (two-tailed) after five episodes are excluded from the analysis. Cohen's *d* = 0.59, a medium effect. There is not equality of variance in this case, with appropriate values being used.

- The scores of *Vague Pronoun References* in the Deceptive group (M = 0.36; SD = 0.71) are significantly different from those of the Truthful group (M = 0.00; SD = 0.00): t(49) = 3.53; p = .001 (two-tailed) after twenty episodes are excluded from the analysis. Cohen's *d* = 0.85, a medium effect. There is not equality of variance in this case, with appropriate values being used.
- The scores of *Verb Strings* in the Deceptive group (M = 1.14; SD = 1.52) are significantly different from those of the Truthful group (M = 0.16; SD = 0.60): t(66) = 4.26; p = <.01 (two-tailed) after fourteen episodes are excluded from the analysis. Cohen's *d* = 0.85, a large effect. There is not equality of variance in this case, with appropriate values being used.
- The scores of *Cognitive Verbs* in the Deceptive group (M = 0.69; SD = 1.02) are significantly different from those of the Truthful group (M = 0.18; SD = 0.42): t(67) = 3.30; p = .002 (two-tailed) after nine episodes are excluded from the analysis. Cohen's *d* = 0.66, a medium effect. There is not equality of variance in this case, with appropriate values being used.

One variable was significant at the .05 level.

- The scores of *Negation* in the Deceptive group (M = 0.71; SD = 1.03) are significantly different from those of the Truthful group (M = 0.29; SD = 0.67): t(89) = 2.44; p = .017 (two-tailed) after eight episodes are excluded from the analysis. Cohen's *d* = 0.48, a small effect. There is not equality of variance in this case, with appropriate values being used.

5.4.4. Episode Clause Count Analysis

Eleven variables were tested using clause count, and unequal variances taken into account where required. With extreme values removed, eight variables are significant at the .01 level:

- The scores of *MoDs* in the Deceptive group (M = 22.29; SD = 16.53) are significantly different from those of the Truthful group (M = 7.78; SD = 11.02): t(94) = 5.34; p = <0.01 (two-tailed) after five episodes are excluded from the analysis. Cohen's *d* = 1.03, a large effect. There is not equality of variance in this case, with appropriate values being used.
- The scores of *Me* in the Deceptive group (M = 8.06; SD = 11.95) are significantly different from those of the Truthful group (M = 0.23; SD = 1.28): t(53) = 4.74; p = <.01 (two-tailed) after fourteen episodes are excluded from the analysis. Cohen's *d* = 0.92, a large effect. There is not equality of variance in this case, with appropriate values being used.

- The scores of *My* in the Deceptive group (M = 14.09; SD = 16.89) are significantly different from those of the Truthful group (M = 5.53; SD = 8.58): t(76) = 3.24; p = .002 (two-tailed) after nine episodes are excluded from the analysis. Cohen's *d* = 0.64, a medium effect. There is not equality of variance in this case, with appropriate values being used.
- The scores of *Third Person Pronouns* in the Deceptive group (M = 25.59; SD = 26.24) are significantly different from those of the Truthful group (M = 13.00; SD = 16.96): t(93) = 2.98; p = .004 (two-tailed) after two episodes are excluded from the analysis. Cohen's *d* = 0.57, a medium effect. There is not equality of variance in this case, with appropriate values being used.
- The scores of *Vague Pronoun References* in the Deceptive group (M = 1.74; SD = 3.66) are significantly different from those of the Truthful group (M = .000; SD = .000): t(48) = 3.32; p = .002 (two-tailed) after eleven episodes are excluded from the analysis. Cohen's *d* = 0.67, a medium effect. There is not equality of variance in this case, with appropriate values being used.
- The scores of *Verb Strings* in the Deceptive group (M = 6.89; SD = 9.30) are significantly different from those of the Truthful group (M = .07; SD = .48): t(51) = 5.27; p = .000 (two-tailed) after 16 episodes are excluded from the analysis. Cohen's *d* = 1.03, a large effect. There is not equality of variance in this case, with appropriate values being used.
- The scores of *Cognitive Verbs* in the Deceptive group (M = 3.82; SD = 5.90) are significantly different from those of the Truthful group (M = .61; SD = 1.65): t(57) = 3.69; p = .001 (two-tailed) after fourteen episodes are excluded from the analysis. Cohen's *d* = 0.74, a medium effect. There is not equality of variance in this case, with appropriate values being used.
- The scores of *Negation* in the Deceptive group (M = 4.20; SD = 6.12) are significantly different from those of the Truthful group (M = 1.57; SD = 3.39): t(82) = 2.70; p = .008 (two-tailed) after eight episodes are excluded from the analysis. Cohen's *d* = 0.53, a medium effect. There is not equality of variance in this case, with appropriate values being used.

Analysis identifies both word and clause counts as productive discriminators between Truthful and Deceptive episodes. For this reason, both word and clause count variables are extended into the One Sample Kolmogorov-Smirnov Test.

5.4.5. One Sample Kolmogorov-Smirnov Test

All the variables in Known Group were tested for goodness-of-fit. This test for Normality compares whether the actual distribution of variables conforms to the expected (hypothetical) distribution in that particular type of sample.

In word analysis, the two-tailed significance of 9 out of the 10 variables are extremely low, indicating that their actual distribution is significantly different from their expected distribution, and not within normal parameters. In only one variable, *First Person Singular Pronouns*, did the One Sample Kolmogorov-Smirnov test of goodness-of-fit provide no evidence against the null hypothesis that the sample has been drawn from a normal population: D = 1.047; exact p = .208 (two tailed) (Figure 89).

In clause analysis, the two-tailed significance of 9 out of the 11 variables are extremely low, again indicating that their actual distribution is significantly different from their expected distribution, and not within normal parameters. Only 2 variables meet the One Sample Kolmogorov-Smirnov test of goodness-of-fit, providing no evidence against the null hypothesis that the samples have been drawn from a normal population: *I* D = 0.082; exact p = .075 (two tailed) and *First Person Singular Pronouns* D = 0.990; exact p = .263 (two tailed) (Figure 90).

Variables	K-S Z	Sig.
MoDs	2.443	.000
I	1.556	.016
Me	3.594	.000
My	2.577	.000
First Person Singular Pronouns	1.047	.223
Third Person Pronouns	2.966	.000
Vague Pronoun References	4.458	.000
Verb Strings	3.687	.000
Cognition Verbs	3.764	.000
Negation	3.970	.000

Figure 89: Known Statements - One Sample K-S Test of Episodes (Word)

Variables	K-S Z	Sig.
MoDs	2.305	.000
I	1.263	.082
Me	3.575	.000
My	2.738	.000
First Person Singular Pronouns	0.990	.280
Third Person Pronouns	2.523	.000
Vague Pronoun References	4.518	.000
Verb Strings	3.362	.000
Cognition Verbs	3.500	.000
Negation	3.727	.000
Clause Length	1.353	.051

Figure 90: Known Statements - One Sample K-S Test of Episodes (Clause)

Only 2 variables meet the assumptions of Normality: *First Person Singular Pronouns* in the word analysis, and *First Person Singular Pronouns* and *I* in the clause analysis.

5.4.6. Levene's Test for Homogeneity of Variance

Word and Clause variables in Known Group of episodes were tested for Homogeneity of Variance. In the word variable analysis, only one variable, *Me* (.001)* shows significantly different variance across the Group (Figure 91), while the remaining nine variables meet the test for equality.

Variables	F	Sig.
MoDs	1.701	.195
I	.925	.338
Me*	11.536	.001*
My	.235	.629
First Person Singular Pronouns	.762	.385
Third Person Pronouns	.001	.978
Vague Pronoun References	.005	.943
Verb Strings	.895	.346
Cognition Verbs	.661	.418
Negation	2.687	.104

Figure 91: Known Statements - Levene's Test of Episodes (Word)

Likewise with the Clause variables, the same variable, *Me* (.031) also shows significantly different variance across the group (Figure 92), with the remaining ten variables meeting the test for equality.

Variables	F	Sig.
MoDs	.669	.415
I	.037	.848
Me*	4.759	.031*
My	.951	.332
First Person Singular Pronouns	1.143	.287
Third Person Pronouns	3.079	.082
Vague Pronoun References	.494	.484
Verb Strings	.048	.827
Cognitive Verbs	.148	.701
Negation	.338	.562
Clause Length	1.549	.216

Figure 92: Known Statements - Levene's Test of Episodes (Clause)

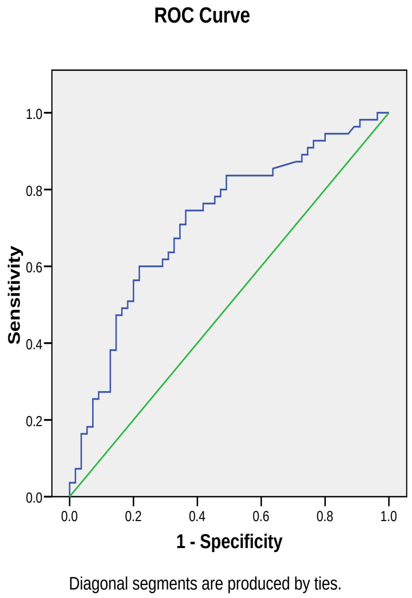
5.5. *Post Hoc Logistic Regression Episode Analysis*

As only two variables, *First Person Singular Pronouns* and *I*, meet the requirements of Normality, Discriminant Function Analysis is deemed not a suitable test to predict category membership. Instead, Logistic Regression is considered more appropriate as it makes fewer assumptions about the data than Discriminant Analysis.

5.5.1. Episode Word Analysis

Logistic Regression analysis was conducted to predict the category membership of 110 episodes using the word count of the 8 independent variables (*I, Me, My,* Third Person Singular Pronouns, Vague Pronoun References, Verb Strings, Cognitive Verbs and Negation) as predictors. A test of the full model against a constant only model was not statistically significant ($\chi^2 = 13.450$, $p = .097$ with $df = 8$), with prediction success overall being only 66.4% (72.7% for Truthful and 60.0% for Deceptive). The Wald criterion demonstrates that only *Me* makes a significant contribution to prediction, $p = .039$.

The area under the ROC Curve is .716 (71.6%), the optimal cut-off value for the probabilities of membership in the Deceptive category being .508 representing a sensitivity of 0.600 (60%) with a 0.218 (21.8%) false alarm rate (1 – Specificity) (Figure 93). Therefore, the probability of a Known Group text being correctly identified as being Deceptive using the eight variables is 60%, with a 22% chance of being a false positive.



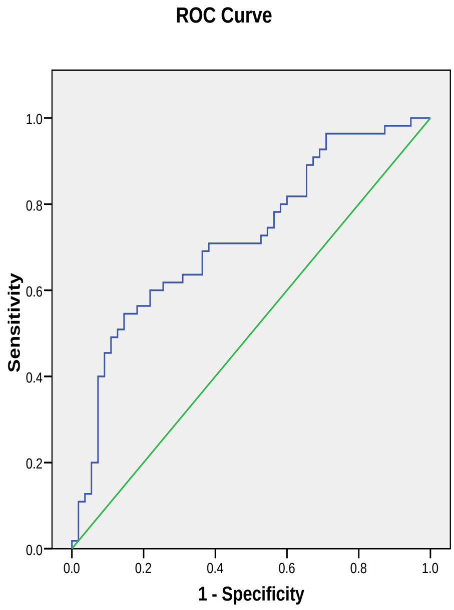
Area	Std. Error	Asymptotic Sig.	95% LCL	95% UCL
.716	.049	.000	.619	.813

Figure 93: Known Statements - ROC Curve Results of Episodes (8 variables)(Word)

5.5.2. Episode Clause Analysis

Logistic Regression analysis was then conducted to predict the category membership of 110 episodes using the clause counts of 9 independent variables (*I, Me, My,* Third Person Singular Pronouns, Vague Pronoun References, Verb Strings, Cognitive Verbs, Negation and Clause Length) as predictors. The predictions are contained in Appendix 1.

A test of the full model against a constant only model was not statistically significant (χ^2 = 15.020, p = .090 with df = 9), with prediction success overall being slightly down on the word count analysis, at 63.6% (63.3% for both Truthful and Deceptive). In this case, the Wald criterion demonstrates that only *Third Person Pronouns* makes a significant contribution to prediction, p = .041, with *My* following, p = .084.



Area	Std. Error	Asymptotic Sig.	95% LCL	95% UCL
.722	.049	.000	.626	.817

Figure 94: Known Statements - ROC Curve Results of Episodes (9 variables)(Clause)

The area under the ROC Curve is .722 (72.2%), the optimal cut-off value for the probabilities of membership in the Deceptive category being .546 representing a sensitivity of 0.600 (60%) with a 0.236 (23.6%) false alarm rate (1 – Specificity) (Figure 94). Therefore, the probability of a Known Group text being correctly identified as being *Deceptive* using the 7 variables is 60%, with a 24% chance of being a false positive.

5.5.3. Post Hoc Prediction Results

Logistic Regression analysis on 110 episodes using word count correctly identifies 40 (73%) of the 55 Truthful episodes, and 33 (60%) of the 55 Deceptive episodes (results are available in Appendix 1). Fifteen episodes are incorrectly identified as *Deceptive* (when they were Truthful), and 22 episodes are incorrectly identified as Truthful (when they were Deceptive). In total, 73 of the 110 episodes (66%) are correctly predicted.

An analysis of the 15 episodes incorrectly identified as *Deceptive* reveals that:

- Seven episodes (1, 67, 78, 79, 80, 81 & 91) were originally designated *Truthful* because their true category was unknown, but their veracity is suspect;
- Three episodes (45, 46 & 49) relate to the same narrative and contain largely reported speech in which the markers are located, which may have affected analysis results;

- Five episodes (21, 30, 78, 79& 94) are short, containing ≤ 25 words.

An analysis of the 22 episodes incorrectly identified as *Truthful* reveals that:

- Eight episodes (36, 37, 68, 72, 74, 76, 84, & 85) are borderline Truthful/Deceptive (between .450 & .499);
- Ten episodes (4, 17, 22, 26, 27, 28, 37, 55, 72 & 99) are short, containing ≤ 25 words.

Logistic Regression analysis on 110 episodes using clause count correctly identifies 35 (64%) of the 55 Truthful episodes, and 35 (64%) of the 55 Deceptive episodes. Twenty episodes are incorrectly identified as *Deceptive* (when they are *Truthful*), and 20 episodes incorrectly identified as *Truthful* (when they are *Deceptive*). In total, 70 of the 110 episodes (64%) are correctly predicted.

An analysis of the 20 episodes incorrectly identified as *Deceptive* reveals that:

- Seven episodes (78, 80, 81, 91 and 97) were originally designated *Truthful* because their true category was unknown, but their veracity is suspect;
- Eight episodes (8, 33, 42, 58, 78, 81, 97 and 102) are borderline Truthful/Deceptive (between .500 and .550);
- Four episodes (45, 47-49) relate to the same narrative and contain largely reported speech in which the markers are located, which may have affected analysis results;
- Six episodes (21, 29, 30, 48, 78 and 102) are short, containing ≤ 25 words.

An analysis of the 20 episodes incorrectly identified as *Truthful* reveals that 9 episodes (4, 17, 22, 26, 27, 28, 55, 72 and 99) are short, containing ≤ 25 words.

There is agreement between word and clause analysis in correctly predicting 30 Truthful episodes and 29 Deceptive episodes. There is also agreement between word and clause in incorrectly predicting 16 Truthful and 10 Deceptive episodes. There were 25 cases of disagreement between them, with word analysis being wrong in 11 cases (Episodes 1, 36, 37, 46, 67, 74, 76, 79, 84, 85 and 94) and clause analysis being wrong in 14 cases (Episodes 8, 20, 29, 33, 42, 47, 48, 51, 53, 56, 58, 70, 97 and 102).

A closer look at these cases of disagreement reveals that:

- Five word analysis cases (Episodes 36, 37, 74, 84 and 85 - *Deceptive*, misidentified as *Truthful*) are borderline Truthful/Deceptive;

- Two word analysis cases (Episodes 1 and 67 - *Truthful*, misidentified as *Deceptive*) were originally designated *Truthful* because their true category was unknown, but their veracity is suspect;
- One word analysis case (Episode 46 - Truthful, misidentified as *Deceptive*) contains largely reported speech in which markers are located, which affects analysis results;
- Six clause analysis cases (Episodes 8, 33, 42, 58, 97, and 102 - *Truthful*, misidentified as *Deceptive*) are borderline Truthful/Deceptive;
- Two clause analysis cases (Episodes 47and 48 - *Truthful*, misidentified as *Deceptive*) contain largely reported speech in which markers are located, which affects analysis results.

In the remaining 7 cases of disagreement, word analysis is wrong in 1 case (Episode 94 – *Truthful*, misidentified as *Deceptive*) and clause analysis is wrong in 6 cases (Episodes 20 and 29 - *Truthful*, misidentified as *Deceptive* and Episodes 51, 53, 56, 70 - *Deceptive*, misidentified as *Truthful*). These disagreements appear to arise from the different weightings that Logistic Regression analysis gives to the linguistic variables used in the equation when conducting word and clause analysis. While the strongest variables for identifying deception in word analysis are *Me* (being the only significant variable) followed by Cognitive Verbs and *My*, in clause analysis they are Third Person Pronouns (being the only significant variable) followed by *My* and *Me* (Figure 95).

Variables in Equation	**Word Sig.**	**Clause Sig.**
I	.272	.459
Me	.039	.146
My	.184	.084
Third Person Pronouns	.744	.041
Vague Pronoun References	.738	.178
Verb Strings	.681	.787
Cognitive Verbs	.166	.268
Negation	.223	.390
Clause Length	-	.537

Figure 95: Known Statements - Linguistic Variable Weightings in LR Analysis

For example, in the disagreement between word and clause analysis for Episode 94 (word analysis - *Truthful*, misidentified as *Deceptive*), a single Cognitive Verb having a higher significance in word (.166) than clause analysis (.268) tips Logistic Regression results (.514) over the .500 cut off value into the Deceptive category. In Episode 29 (clause analysis - *Truthful*, misidentified as *Deceptive*), a single Vague Pronoun Reference occurring in a very short episode (two clauses totalling 7 words), having a higher significance in clause (.178) than word analysis (.738) results in the episode being incorrectly designated as Deceptive.

The majority of disagreements appear to arise from the use of *Third Person Pronouns* in Logistic Regression clause analysis, which the Wald criterion identifies as making the only significant contribution to the prediction. However, earlier qualitative analysis indicates that truth tellers make greater use of the pronouns than deceivers, although in Deceptive Statements, Third Person Pronouns tend to concentrate in Deceptive episodes. Therefore, given this limitation as well as overall results, it is safer to pick the word result over clause result in identifying deception, particularly when there is disagreement between word and clause prediction.

5.5.4. Variable Cut-Off Values

Further Logistic Regression analysis was conducted using variable cut-off values between .400 and .600 at .050 increments to determine whether a better fit was obtainable (Figure 96).

Word analysis using a cut-off value of .450 increases overall accuracy rates slightly to 67% (from 66%), while increasing the rate of correctly identified Deceptive episodes to 76% (from 60%); however, accuracy rates for identifying Truthful episodes are reduced to 58% from 73%. Clause analysis using a cut-off value of .550 increases overall accuracy even further to 69% (from 64%), although this is largely due to an improvement in the identification of Truthful episodes (78%), while accuracy in identifying Deceptive episodes is reduced to 60% (down from 64%).

Adjusting cut-off values down to .450 for word analysis predictions only results in 22 cases of disagreement, with word analysis being wrong in 9 cases (and clause analysis wrong in 13 cases). The adjustment also changes the predicted category of 17 episodes, of which only 9 change in the correct direction.

Adjusting cut-off values up to .550 for only clause analysis results in 23 cases of disagreement, with clause analysis being wrong in 10 cases (and word analysis wrong in 13 cases). The adjustment also changes the predicted category of 10 episodes, of which 8 episodes change in the correct direction.

Cut-off value .400	**Word**	**Clause**
Episodes Correct Truthful	24 (44%)	22 (40%)
Episodes Correct Deceptive	46 (84%)	44 (80%)
Episodes Overall Correct	70 (64%)	66 (60%)

Cut-off value .450	**Word**	**Clause**
Episodes Correct Truthful	32 (58%)	31 (56%)
Episodes Correct Deceptive	42 (76%)	39 (71%)
Episodes Overall Correct	74 (67%)	70 (64%)

Cut-off value .500	**Word**	**Clause**
Episodes Correct Truthful	40 (73%)	35 (64%)
Episodes Correct Deceptive	33 (60%)	35 (64%)
Episodes Overall Correct	73 (66%)	70 (64%)

Cut-off value .550	**Word**	**Clause**
Episodes Correct Truthful	46 (84%)	43 (78%)
Episodes Correct Deceptive	27 (49%)	33 (60%)
Episodes Overall Correct	73 (66%)	76 (69%)

Cut-off value .600	**Word**	**Clause**
Episodes Correct Truthful	47 (85%)	48 (87%)
Episodes Correct Deceptive	23 (42%)	27 (49%)
Episodes Overall Correct	70 (64%)	75 (68%)

Figure 96: LR Prediction Comparison with Variable Cut-Off Values

Adjusting cut-off values for both word and clause analysis at the same time does not improve results, increasing disagreement in 26 episodes, with word analysis being wrong in 14 episodes, and clause analysis in 12 episodes.

Variable cut-off values do not improve the prediction accuracy of certain episodes, whose predicted categories remain unchanged.

Word analysis

- *Truthful*, incorrectly predicted *Deceptive* – Episodes 1, 21, 30, 39, 41, 45, 46, 49, 67, 78, 79, 80, 81, 91 & 94.
- *Deceptive*, incorrectly predicted *Truthful* – Episodes 4, 17, 22, 24, 26, 27, 28, 35, 55, 89, 99, 100 & 103.

Clause analysis

- *Truthful*, incorrectly predicted *Deceptive* – Episodes 20, 21, 29, 30, 39, 41, 45, 47, 48, 49, 80 & 91.
- *Deceptive*, incorrectly predicted *Truthful* – Episodes 4, 17, 22, 24, 26, 27, 35, 51, 53, 55, 56, 68, 70, 72, 89, 99, 100, 101 & 103.

Of the above 39 episodes, 6 episodes were originally labelled *Truthful* (although suspected to be *Deceptive*) because their true status was unknown; 5 Truthful episodes were predicted *Deceptive* because of their reported speech content; and 17 episodes have ≤ 25 words, too short to be meaningfully analysed.

5.6. *A Priori Logistic Regression (Group 2 Statements)*

Logistic Regression (LR) was also used to predict *a priori* the classification of the Blinded Statements (379 episodes) based on variables identified in the Known Statements analysis. The predicted probability was for membership of the Deceptive category, with a cut-off value of ≥ 0.500. LR word and clause analysis predicted the classification of 256 (67%) of the 379 episodes identically.

The Blinded Group's episode predictions are shown in Appendix 2, each episode numbered individually with its word and clause value and the predicted category membership (1 = *Truthful*, 2 = *Deceptive*). The episodes are grouped according to the Statements to which they belong (shown alternately in bold and plain text) e.g. Episodes 111-116 in bold belong to one Statement, while Episodes117-132 belong to the next Statement, etc. Asterisks next to episode numbers identify disagreements between word and clause predictions.

LR word analysis predicted 160 episodes to be *Truthful* and 219 episodes to be *Deceptive*, while LR clause analysis predicted 147 episodes to be *Truthful* and 232 episodes to be *Deceptive*. Word and clause analysis predictions disagree with each other in 123 episodes (32%). Of these, 54 episodes which word LR analysis predicted to be *Deceptive* were predicted to be *Truthful* using LR clause analysis; 69 episodes predicted to be *Deceptive* using LR clause analysis were predicted to be *Truthful* using LR word count.

Adjusting word analysis cut-off values down to .450 results in 113 cases of disagreement with clause analysis results; adjusting clause analysis cut-off values up to .550 results in 123 cases of disagreement with word analysis results. Adjusting both word and clause values at the same time results in 119 cases of disagreement between them.

5.7. *Conclusion*

To summarise, statistical analysis of the Known Statements using clause count as a measurement (identified as more productive than word count by Independent Sample T-Tests) was carried out using Discriminant Function Analysis and 9 variables (*MoDs, I, Me, My, First Person Singular Pronouns, Third Person Pronouns, Verb Strings, Cognitive Verbs* & *Negation*). This correctly classified 93% of Statements (90% of Deceptive Statements and 100% of Truthful Statements. A second analysis conducted using 7 variables (removing MoDs and First Person Singular Pronouns as their individual components were already being tested) also resulted in an overall accuracy rate of 93% (this time correctly classifying 100% of Deceptive Statements and 80% of Truthful Statements). These 7 variables were extended to predicting deception in the Blinded Statements, which resulted in 15 Statements (nos. 16, 18, 19, 21-24, 28, 34-40) being categorised as *Truthful*, and 10 Statements (nos. 17, 20, 25-27, 29-33) categorised as *Deceptive*.

To get around the problem of overfitting associated with the small test size, individual Statements from the Known Group were divided into their constituent episodes, with each episode being treated as one 'Statement'. Discriminant Function Analysis being unsuitable for analysis (with only *First Person Singular Pronouns* and *I* meeting the requirement for Normality), Logistic Regression was used instead. Both word and clause measurements were deemed suitable for Logistic Regression analysis, with *Me* identified as a significant discriminator using word prediction, and *Third Person Pronouns* for clause prediction. One hundred and ten episodes from the Known Statements were predicted *post hoc*, with word analysis successfully categorising 60% of Deceptive Statements, achieving an overall accuracy rate of 66%; clause analysis had an overall accuracy rate of 64%, successfully identifying 64% of Deceptive Statements.

Although the episode results were not as successful as those of the whole-statement level, they show that the 7 variables (*I, Me, My, Third Person Pronouns, Verb Strings, Cognitive Verbs* & *Negation*) in combination are able to detect deception successfully well above chance, at least in the Known (Group 1) Statements. Episode prediction accuracy could not be expected to be as high as that of whole Statements given the small text size of many episodes. Short episodes magnify the weightings of single variables in them, compared to a longer episode, so future analysis might consider removing such episodes from analysis.

Discriminant Analysis identifying *My* as being the most significant deception indicator at the whole-statement level confirms qualitative analysis findings. This is significant in deception research, not having been identified or even considered by other researchers previously, as is the identification of *Me* as a deception cue for episode word analysis. Both these findings re-write the view that all First Person self-references are ‘honesty’ indicators.

The question at this stage arises whether the same variables will perform as well when extended to a larger group of Statements. At this stage, the actual categories of the Statements remain unknown. Results of predictions made for the Blinded Group follow in the next chapter when the Statements are unblinded.

CHAPTER 6

6. Double Blind (Group 2) Statement Predictions

6.1. *Unblinding the Results*

In this chapter, the categories of the Blinded Group Statements are revealed, and compared to those predicted by informed expert opinion and by Discriminant Function Analysis. The categories of episodes are also revealed and are compared to the predictions made using Logistic Regression (using word and clause measurement). However, as with the Known episodes analysis, informed expert opinion made no predictions as to episode categories.

Up to this point in the study, the actual categories of the Blinded Group 2 Statements remain hidden, and all predictions regarding the categories of Statements and their episodes were made blinded. As stated earlier, this is the first time that research into linguistic cues of deception has been undertaken using a blind study, with the only other previous study into high stakes textual deception analysing texts retrospectively (already knowing whether they were truthful or deceptive). Only after the completion of qualitative, descriptive and statistical analyses and the predictions of Statement categories were the actual categories of the Blinded Statements revealed.

At the point of unblinding, however, it became apparent that the law enforcement sources were less certain about the truth or deceptiveness of some Statements than others. This makes the level of certainty regarding the categories of the unblinded Statements poorer than that of the Known Statements. The level of certainty is high in the case of 13 Statements, and less certain in the case of 12 Statements. As a consequence, the 4-way category developed for the Blinded Statement predictions (In Chapter 4) is extended here to reflect these varying levels of certainty:

- Statements known by the law enforcement source to be truthful or deceptive are labelled *Truthful* (1) or *Deceptive* (2). In these cases, the truth or falsehood of the information is undoubted, established by investigation, witness or forensic evidence, authors' admissions, and court judgments, and the files closed.
    - o 7 Truthful Statements (Statement nos. 16, 19, 21, 24, 27, 28 & 35);
    - o 6 Deceptive Statements (Statement nos. 18, 20, 23, 26, 30 & 36);

- Statements relating to cases where the files remain open (for various reasons), but the law enforcement source has a strong view as to the truth or falsehood of the Statements, are labelled *Believed Truthful* (B1) or *Believed Deceptive* (B2). For example, one Statement relates to a report of a third party murder which the author subsequently admitted was false; the file on this murder, however, remains open and the Statement is labelled *Believed Deceptive (B2)*.
    - o 5 Believed Truthful Statements (Statement nos. 32, 33, 34, 37 & 40)
    - o 7 Believed Deceptive Statements (Statement nos. 17, 22, 25, 29, 31, 38 & 39)

6.2. *Unblinded Whole Statements*

In the table below (Figure 97), each Unblinded Statement is identified by its number and the category as predicted by informed expert opinion, Discriminant Function Analysis, and as identified by the law enforcement source.

Statement No.	Informed Expert Prediction	*a priori* DFA Prediction	Unblinded Category
16	1	1	1
17	2	2	B2
18	2	1	2
19	1	1	1
20	2	2	2
21	1	1	1
22	2	1	B2
23	2	1	2
24	1	1	1
25	2	2	B2
26	2	2	2
27	B1	2	1
28	1	1	1
29	2	2	B2
30	B2	2	2
31	2	2	B2
32	B1	2	B1
33	1	2	B1
34	1	1	B1
35	1	1	1
36	2	1	2
37	1	1	B1
38	1	1	B2
39	1	1	B2
40	1	1	B1

Figure 97: Statements Results compared with Qualitative and Quantitative Analysis Predictions

Expert informed opinion based on overall cue count, cue interaction, and the identification of linguistic strategy, achieved the best results in predicting the category of the Unblinded Statements:

- 5 *Deceptive* Statements and 5 *Believed Deceptive* Statements were predicted *Deceptive*;
- 1 *Deceptive* Statement was predicted *Believed Deceptive*;
- 2 Believed Deceptive Statements were predicted *Truthful*;
- 6 Truthful Statements and 4 Believed Truthful Statements were predicted *Truthful*;
- 1 Truthful Statement and 1 Believed Truthful Statement were predicted *Believed Truthful*;

		Predicted			
		Truthful	**Believed T**	**Deceptive**	**Believed D**
Actual	**Truthful**	6	1	0	0
	Believed T	4	1	0	0
	Deceptive	0	0	5	1
	Believed D	2	0	5	0

Figure 98: Confusion Matrix for Informed Expert Opinion Predictions

Considering only the outright predicted *Truthful* or *Deceptive* results, informed expert opinion correctly identified 77% of Deceptive Statements and 83% of Truthful Statements, achieving an overall 80% accuracy with no false positives. If predictions of *Believed Truthful* or *Believed Deceptive* are taken to mean *Truthful* or *Deceptive*, then an even higher 85% accuracy was achieved in predicting deception, with 100% of Truthful Statements identified, and an overall accuracy rate of 92%.

Discriminant Function Analysis (using 7 independent variables: *I*, *Me*, *My*, Third Person Pronouns, Verb Strings, Cognition Verbs and Negation) achieved overall 64% accuracy identifying 54% of Deceptive Statements and 75% of Truthful Statements, with 3 false positives.

- 3 Deceptive Statements and 4 Believed Deceptive Statements were predicted *Deceptive*;
- 3 Deceptive Statements and 3 Believed Deceptive Statements were predicted *Truthful*;
- 6 Truthful Statements and 3 Believed Truthful Statements were predicted *Truthful*;
- 1 Truthful Statement and 2 Believed Truthful Statements were predicted *Deceptive*.

Predicted

Actual	Truthful	Believed T	Deceptive	Believed D
Truthful	6	0	1	0
Believed T	3	0	2	0
Deceptive	3	0	3	0
Believed D	3	0	4	0

Figure 99: Confusion Matrix for DFA Predictions

Both informed expert opinion and statistical analysis correctly identified the same 7 Deceptive and 9 Truthful Statements, and misidentified as *Truthful* the same 2 Statements (nos. 38 and 39) believed Deceptive by the law enforcement source. Given that both analyses are largely based on the same cues (or their absence), this is not surprising. However, compared to the success of the *post hoc* Known Statement predictions, the *a priori* Blinded predictions are a poor result (Figure 98).

Group 1 Statements Predictions		Group 2 Statements Predictions	
Correct Truthful	80%	Correct Truthful	75%
Correct Deceptive	100%	Correct Deceptive	54%
Overall Correct	93%	Overall Correct	64%

Figure 100: Known and Blinded Statements DFA Prediction Results

Although Discriminant Analysis correctly predicted a high number of Truthful Statements in the Unblinded Group, this appears to arise from missing the deception cues in Deceptive Statements. Therefore, while it appears that Discriminant Analysis is correctly identifying Truthful Statements, in fact, it is incorrectly identifying Deceptive Statements as *Truthful* as the cues so successfully used in the Known Statements *post hoc* predictions to identify 100% of Deceptive Statements do not quite fit with the Blinded set. The one good thing that can be said for the Blinded Statement predictions is that the number of false positives is low.

6.3. *Unblinded Episodes*

The level of uncertainty regarding 13 of the 25 Blinded Statements presents difficulties with episode analysis. To compensate for the uncertainty, a wider truth bias was applied to the labelling of individual episodes. Statements that the law enforcement source identified as *Truthful* or *Believed Truthful* have all their episodes labelled *Truthful*; Statements identified as *Deceptive* or *Believed Deceptive* have only the episodes that cover the criminal event labelled *Deceptive* (2), with all other episodes labelled *Truthful* (1). Consequently, it is expected that Deceptive episodes have been incorrectly labelled *Truthful*. It is also inevitable that some Truthful episodes will be incorrectly labelled *Deceptive,* as very short episodes may contain truthful information but have been labelled *Deceptive* as they fall within the deceptive criminal event reported. However, it is hoped that this has been kept to a minimum.

Episodes belonging to Statement no. 34 (episodes 356-452), written by the individual with a psychological disorder, were excluded from the analysis as the language in the narrative would be heavily influenced by the author's unusual condition and is not realistically representative of the wider population.

This leaves 282 episodes in total, of which 157 episodes are labelled *Truthful* and 125 are labelled *Deceptive*. The Table containing the Unblinded results is found at Appendix 3.

6.3.1. Episode Word Prediction

Word measurement analysis correctly predicted 185 of the 282 episodes (66%):

- 92 Truthful episodes (59%);
- 93 Deceptive episodes (74%).

Ninety-seven episodes (34%) were incorrectly predicted:

- 32 episodes incorrectly predicted *Truthful*;
- 65 episodes incorrectly predicted *Deceptive*.

		Predicted	
		Truthful	**Deceptive**
Actual	**Truthful**	92	65
	Deceptive	32	93

Figure 101: Confusion Matrix for LR Predictions (Word)

An analysis of the 65 Truthful episodes incorrectly predicted *Deceptive* identified that:

- 28 episodes are short episodes (≤ 25 words);
- 8 episodes (of which 2 episodes are also short episodes) are borderline Deceptive (.500-.550); and,
- in 18 episodes, their clause counterparts were correctly predicted to be *Truthful*.

An analysis of the 32 Deceptive episodes incorrectly predicted *Truthful* identified that:

- 15 episodes are short episodes (25 words or less);
- 10 episodes (of which 2 episodes are also short episodes) are borderline Deceptive (.450-.499); and,
- in 9 episodes, their clause counterparts were correctly predicted to be *Deceptive*.

6.3.2. Episode Clause Predictions

Clause measurement alone correctly predicted 155 of the 282 episodes (55%):

- 75 Truthful episodes (48%);
- 80 Deceptive episodes (64%).

One hundred twenty-seven episodes (45%) were incorrectly predicted:

- 45 episodes incorrectly predicted *Truthful*;
- 82 episodes incorrectly predicted *Deceptive*.

Actual	Predicted: Truthful	Predicted: Deceptive
Truthful	75	82
Deceptive	45	80

Figure 102: Confusion Matrix for LR Predictions (Clause)

An analysis of the 82 Truthful episodes incorrectly predicted *Deceptive* identified that:

- 35 episodes are short episodes (25 words or less);
- 20 episodes (of which 7 episodes are also short episodes) are borderline *Deceptive* (.500-.550); and,
- in 38 episodes, their word counterparts were correctly predicted *Truthful.*

An analysis of the 45 Deceptive episodes incorrectly predicted *Truthful* identified that:

- 20 episodes are short episodes (25 words or less);
- 9 episodes are borderline Deceptive (.450-.499); and,
- in 28 episodes, their word counterparts were correctly predicted to be *Deceptive*.

Both word and clause measurement agree with each other in correctly predicting the same 120 episodes (43%), 54 being Truthful (34%) and 66 being Deceptive episodes (53%). There is also agreement in incorrectly predicting the same 60 episodes (21%), with 19 episodes incorrectly predicted *Truthful* and 41 episodes incorrectly predicted *Deceptive*.

6.4. *Discussion*

6.4.1. Whole Statement Predictions

Informed expert opinion was the most successful in predicting truth or deception in the Blinded Statements. Predicting deception of the basis of analysing overall cue interaction and identifying the deceptive linguistic strategy at work achieved an overall 80% accuracy, identifying correctly 77% of Deceptive Statements, with no false positives. If correct *Believed* predictions are taken into account, an overall 92% accuracy was achieved, correctly predicting 85% of Deceptive Statements and 100% of Truthful Statements. It has to be stressed that in this study, strategy analysis only predicts Truthfulness in the absence of the right balance of cues to suggest deception. In that respect, there is a truth bias to the analysis.

Quantitative analysis using Discriminant Function Analysis achieved an overall 64% accuracy, correctly identifying 54% of Deceptive Statements, with 3 false positives (12%).

Group 2 Statements Predictions Informed Expert Opinion		**Group 2 Statements Predictions Discriminant Analysis**	
Correct Truthful	83 (100)%	Correct Truthful	75%
Correct Deceptive	77 (85)%	Correct Deceptive	54%
Overall Correct	80 (92)%	Overall Correct	64%

Figure 103: Blinded Statements Prediction Results

It is interesting to note that informed expert opinion and quantitative analysis both correctly predicted the same 7 Deceptive and 9 Truthful Statements, and misidentified as *Truthful* the same 2 Deceptive Statements. However, Discriminant Function Analysis misidentified a further 7 Statements. Expert opinion predicted two of these Statements (nos. 27 and 32) as *Believed Truthful* on the basis of inconsistency in cue interactions in keeping with a deceptive strategy, which Discriminant Analysis identified as *Deceptive*. The cues were there (which Discriminant Analysis picked up) but the balance was wrong (which Discriminant Analysis did not).

Expert opinion predicted deception in another Statement (no. 18) because of cue clustering in a single episode, which Discriminant Analysis did not detect as the Statement was largely truthful and the amount of truthful language (which contained minimal deception cues) masked the weightings of cues found in that one episode. Similarly, Discriminant Analysis identified a further 3 Statements (nos. 22, 23 and 36) as *Truthful* because cues were not present in large enough numbers overall, although informed expert opinion identified them as *Deceptive* based on cue interaction. For example, Statement no. 22 was labelled as *Truthful* because of low cue numbers, although the increasing depersonalised nature of the language in its last three episodes (with the author largely absent except through the use of *My*) identified the Statement as *Deceptive*.

Discriminate Analysis was caught out by the classic scenario of cues wrongly misinterpreted as indicating deception. Discriminant Function analysis incorrectly identified certain Statements as *Deceptive* based on the cues they contained, although the cues that arose from the context of the situation did not indicate deception but uncertainty arising out of real confusion. In Statement no.27, the author tries to make sense of what she hears going on in an adjoining room (a suicide), which results in much uncertainty on her part, leading to high use of MoDs. However, although the ambiguity cues were present, the unusual pronoun interactions expected to accompany those cues as part of a deceptive strategy were not. Discriminant Analysis also incorrectly identified another Statement (no. 33) as *Deceptive* due to the high incidence of *Me;* however, expert opinion identified the Statement as *Truthful* because a high incidence of *Me* was the only unusual feature, and associated unusual cue interactions were lacking. This suggests that, in this respect, deceptive strategy analysis is less likely to be caught out by deception misjudgements such as the Othello Error.

The failure of Discriminant Analysis to match the high success prediction rates it achieved in the Known Group is probably the result of *overfitting*. Cues that discriminated so successfully between Truthful and Deceptive Statements in the small test group did not perform as successfully in a wider population. Whereas Discriminant Analysis correctly identified all Deceptive Statements in the Known Group, it managed to identify only just over half the Deceptive Statements in the Unblinded Group.

This does not mean that the cues are invalid as deception predictors. Several of the same cues were used by the informed expert to analyse the Blinded Statements, with good results. This strengthens the argument for the importance of placement and interaction of cues, which statistical analysis was unable to take into consideration when making its predictions.

6.4.2. Episode Predictions

Logistic Regression analysis was used to predict the categories of the Blinded episodes, but no predictions were made using informed expert opinion. As with episodes from the Known Group, such predictions would have involved looking at cues in isolation within episodes instead of cue interaction and linguistic strategy in progression. Therefore, only Logistic Regression predictions using word and clause as measurements were carried out.

The contradictory results between word and clause analysis is an example of the difficulties associated with trying to identify the Pinocchio's nose of linguistic deception. If under different measurements cues cannot be consistent, what hope is there for cross-context predictions?

The identification by Logistic Regression of Third Person Pronouns as a significant predictor of deception (using clause measurements) conflicts with Discriminant Function Analysis, which ranks the pronouns fifth out of 7 variables (*My*, *Verb Strings*, *Negation*, *Cognition Verbs*, *Third Person Pronouns*, *Me* & *I*). It also conflicts with qualitative analysis findings in the Known Statements that truth tellers make greater overall use of Third Person Pronouns than deceivers. However, one possible explanation for this selection by Logistic Regression is the finding in the qualitative analysis of episodes (in the Known Group) that Third Person Pronouns tend to concentrate in the Deceptive episodes of Deceptive Statements. It may be that Logistic Regression identified this feature during its analysis. Consequently, while the pronouns may be helpful in identifying Deceptive episodes in Deceptive Statements, they incorrectly label episodes as *Deceptive* in Truthful Statements, leading to poor clause analysis results.

Surprisingly, the overall accuracy rate using word analysis of the predicted Unblinded episodes is identical to that of the Known Group episodes, at 66%. As with the Known episodes results, Logistic Regression analysis using word as a measurement is a better predictor than clause measurement; the results are more often correct when word and clause results conflict and they are better at identifying deception.

Group 1 Episodes *post hoc* predictions	**Word**	**Clause**
Correct Truthful	73%	64%
Correct Deceptive	60%	64%
Overall Correct	66%	64%

Group 2 Episodes *a priori* predictions	**Word**	**Clause**
Correct Truthful	59%	48%
Correct Deceptive	74%	64%
Overall Correct	66%	55%

Figure 104: Comparison of Group 1 and Group 2 Logistic Regression Analysis - Episodes Prediction Results

Why should word as a measurement at the episode level be a better predictor than the clause, when clause measurements were more productive at the whole Statement level? It may be that it is not the measurement preference but the cues they capture. There can only ever be one *Me* in any one clause, although there can be any number of Third Person Pronouns. Therefore, heavy use of Third Person Pronouns would not have the same impact when being measured on a clause basis, compared to its use against total word count.

A limitation in the study exists in that the certainty of categories of the Unblinded episodes is much lower than that of the Known (Group 1) episodes. Additional weaknesses also lie in the fact that both word and clause predictions rely on a single predictor to make a significant contribution for each measurement. Short episodes also magnify the weighting of individual cues contained within them, which at times leads to incorrect *Deceptive* designations on the basis of a single cue, as was found in the *post hoc* predictions of the Known Group episodes. For example, the very short episode -- *about five minutes later* ***he*** *leaned back over and kissed* ***me*** *again* -- was incorrectly labelled *Deceptive* by both word and clause analysis because of the presence of a single cue which is heavily weighted in their respective analysis. Although both word and clause analysis agreed (incorrectly) in this case, disagreements between them in predicting truth or deception arise because of the different weighting given by Logistic Regression analysis to the linguistic cues used in the equations. In another example, the extremely short Truthful episode -- *but if* ***it*** *got worse to take* ***her*** *to the ER* -- was predicted to be *Truthful* by word measurement (because there were no cues present which word Logistic Regression analysis considered significant) but *Deceptive* by clause count because of the Third Person Pronouns *it* and *her*.

One option would be to remove all short episodes from future analysis to reduce incorrect predictions generally. Twenty-eight of the 65 episodes incorrectly predicted to be *Deceptive* by Logistic Regression word analysis are short episodes, as are 35 of the 82 episodes incorrectly predicted to be *Deceptive* using clause measurement. In both cases, 43% of incorrectly predicted episodes have 25 words or less.

In the Known episodes, correct predictions were higher for Truthful than Deceptive Statements; this is reversed for the Unblinded Statements. The accuracy rate for predicting deception in the Unblinded episodes (74%) is higher than that for the Known episodes (60%), which might be considered a good result were it not for the high false positive rate of 23% (compared to 14% false positive rate in the Known episode predictions). Thus, Logistic Regression predictions identified more Deceptive episodes correctly because it identified more episodes overall to be deceptive (incorrectly), resulting in a low Truthful prediction of 59%.

These results agree with previous research in suggesting that Third Person Pronouns are inconsistent predictors of deception. The same applies to *Me*, although this study is the only one to have examined the pronoun (as with the self-references *I* and *My*) individually to date.

6.5. *Conclusion*

In this chapter, the categories of the 25 Blinded Statements were finally revealed after being kept hidden since the beginning of this study. However, once the Statements were unblinded, it was apparent that the level of certainty of classification was much lower than that in the Known Group. This constitutes a limitation of this study.

The cues, which appeared so promising at identifying deception in the small test set did not perform as well with the larger group of Unblinded Statements, identifying deception at just above chance. This does not mean that the cues identified in the Known Group were wrong; after all, the structured approach used by informed expert opinion used the same cues with much greater success. It is probably the case that the test group was too small, and cue behaviour too specific to that group to be extended to a wider population. Therefore, the cues are neither proved nor disproved.

Having said that, a look at the strength of cues in the wider group of Statements (40 Statements - combined Known and Unblinded Statements) reveal that some of the conclusions arrived at from analysing cues in the Known Group remain valid for the Statements as a whole. However, their validity as predictors of deception appears to be linked to their association with other cues, and not on an individual basis.

Self-references are indeed not weighted all the same and some of them are associated with deception, contrary to previous research. Overall results for *Me* and *My* not only confirm the earlier qualitative analysis, but strengthen it, as do results for Verb Strings, Negation and the combined cue MoDs set. However, the earlier finding in the Known Statements of a positive correlation between deception and increased use of Vague Pronoun References and Cognitive Verbs is less clear. On average, in the Unblinded Statements, these cues are used more by truth tellers than deceivers. The contradictions continue in the case of Third Person Pronouns, whose increased use was a feature of truth telling in the Known Statements; this is reversed in the unblinded Statements, and deceivers use more of them. However, this does not disprove their effectiveness as deception cues, as earlier episode analysis indicated that these cues tended to be located in the Deceptive episodes of Deceptive Statements; so their distribution may be more important than their numbers. It would help to be able to analyse the distribution of these cues between Truthful and Deceptive episodes in the Unblinded Deceptive Statements; unfortunately, given the uncertainty surrounding the classification of the Unblinded episodes, such a study is not practical. This is left to a further study to explore in the future.

Given the overall low accuracy rates for episode predictions in both the Known and Unblinded Groups, treating episodes as if they are Statements in their own right is probably not a viable option for a number of reasons. First, by their nature, many episodes will be too short for effective analysis, even if they are longer than the “short episodes” (≤ 25 words) in this study. As Deceptive Statements tend to fragment into shorter episodes, this makes analysing for deception impractical at the episode level in Deceptive Statements. Second, predicting deception with only a single cue making a significant contribution to the identification is akin to pretending it is the Pinocchio’s nose for episode analysis. There is no way of knowing at this stage how well a single predictor such as *Me* extends to an even wider population of episodes; this remains to be tested. In a future study using a larger sample set, statistical analysis may find additional features so as to use cues in interaction to predict deception also at the episode level.

The success of the deception predictions using cue interaction and progression is very interesting. Its high success rates of 80% (92%) -- correctly identifying 77% (85%) of Deceptive Statements and 83% (100%) of Truthful Statements -- were completely unexpected. However, its superiority to statistical analysis should not come as a surprise, but it does not necessarily mean that informed expert opinion is better than a machine at identifying deception. A statistical model is only as good as the data that is put in and the analysis it is trained to conduct. It merely means that in this study, man and machine approached deception detection differently.

Perhaps referring to the structured approach of identifying strategic interactions as ‘informed expert opinion’ is a misnomer. As much as possible, decisions were made objectively and deception was identified on the interaction and balance of *I*, *Me*, *My*, Third Person Pronouns, MoDs, prolixity, and episode fragmentation. A small degree of subjective decision-making was necessary to accommodate the flexibility of deceptive language adaptation to contexts; but otherwise, ‘opinion’ was kept out of the analysis. In fact, ‘opinion’ proved to be a weakness. Expert ‘opinion’ did not always agree with that of the structured approach in deciding whether a Statement was deceptive or not; but in every case of disagreement, the structured approach won. Given that a structured approach is what it claims to be, a machine can probably be trained to do it better than a human.

CHAPTER 7

7. Conclusion

7.1. Innovations and Findings of the Study

This study originally set out to discover a unified theory for deception detection and a structured approach for textual analysis. In the process, it discovered that perhaps it may be beyond the ability of a unified theory to describe the complexity of deceptive linguistic behaviour; nevertheless, an innovative approach to analysing deceptive textual narratives is proposed, which takes deception analysis in a new direction.

7.1.1. Major Innovations Summary

The major innovations of this study include:

- the use of material from real life high stakes textual deception;
- the individual analysis of *I*, *Me* and *My* and their association with deception;
- a cue interaction-centred approach to deception detection;
- an episode progression approach to identifying deceptive linguistic strategy;
- testing the effectiveness of cues by predicting deception in a double blind study;
- pitting informed expert opinion against statistical analysis to test the effectiveness of respective analysis techniques in a double blind study.

7.1.2. Major Findings Summary

This study contains three major findings:

- Deception is more effectively identified by the linguistic strategy at work, than by a Statement's linguistic profile. This study provides empirical evidence which shows that the predictive value of linguistic cues lies in the way they are used, and depends on the presence or absence of other cues. Cue placement and interaction matters.
- The use of First Person Pronouns as indicators of honesty (as found in previous deception research) does not apply to deception in written witness statements. The pronouns are not all equally weighted and *My* is an effective deception predictor.
- Narrative fragmentation into many short episodes is linked to deception.

7.2. The Research Design

Previous deception research has been guided by theoretical perspectives as to how language might behave under deceptive conditions. However, a weakness of much research has been the reliance on poor models of deception and low stakes lying. To date, there has been much contradiction in research findings, with no Pinocchio's nose, which raises questions regarding the validity of cues identified and their applicability to real world high stakes deception, particularly in textual deception analysis.

Witness Statements were selected as a medium for this study because they met the fundamental requirements for innovative and serious deception analysis: firstly, textual monologue is a largely unexplored medium; secondly, the Statements concern real people in real world events; thirdly, they involve high stakes deception. The consequences of being caught lying would have serious implications for their authors' reputation, liberty, and even life. The motivation for deceivers to succeed with their lies could not get much higher. This, according to theory, would maximise the impact of deception on language and create linguistic deception cues that are less faint.

However, the flexibility of deceptive language and the lack of consistency in cue findings to date make a complete rethink of the fundamentals of deception necessary in order to identify a new more productive approach to analysis. It may not be the case that deception produces weak cues, but rather a new approach is needed to find them.

The design of this study commenced with a return to the origins of deception – in evolution – to rethink a new theoretical approach. The success of deception, like evolution, lies in its variation. Consistency equates to a predictable pattern of response, which is unlikely to enhance liars' chances of success. Thus, looking for consistency and the obvious in deception cues is not likely to produce results.

The second issue lay in redefining the research definition of deception. The view of deception as a single act at a single point in time has dictated the way deceptive language has been analysed in the past. If this is not producing results, then two possibilities exist: the first is that deceptive language is indeed infinitely variable and inconsistent; the second is that there are problems with its definition (and the methodological approach to capturing it).

The solution to this issue lies in the nature of the Witness Statement material itself. Telling a story involves constructing a timeline. Lying in a narrative involves creating an alternative reality that has to be fitted into the storyline and anchored in real time and place. Thus, deception in narratives involves a sequence of lies to make the false reality credible and fit in with the known and real facts; consequently, deception has to be a progression.

Analysing a progression requires a different approach to that of analysing overall cues. Techniques for partitioning narratives employed by statement analysts have inherent weaknesses which make its use unsatisfactory. Again, a new approach is required.

This approach was identified in the chance reading of a paper on the discourse nature of ordered events. When creating narratives, storytellers create linguistic signposts to identify the beginning of new thematic bundles (and the closure of old ones). In effect, narratives are composed of a succession of such bundles – each one identifying a change in the focus of authors as they tell their stories. Such episodes provide the vehicle for analysing deception as a progression in written narratives.

The deconstruction of narratives into their constituent episodic sequences, identifying the linguistic profile of each episode, and analysing the changing pattern of cue use in the language in order to identify the author's deceptive linguistic strategy is a major innovation of this study. Without episode analysis, identifying linguistic strategy would be extremely difficult. To some extent, this is possible by analysing cues on a whole-statement level and identifying how the cues relate to each other. However, this only provides a snapshot of the overall picture, which may not be a correct reflection of what is going on within the statement, particularly if it is largely truthful, in which case the language will mask that of the deceptive strategy at work.

7.3. The Main Findings

7.3.1. Linguistic Strategies

Two main linguistic strategies associated with deception were identified based on overall cue levels and their interaction with other cues. These strategies were identified as a result of mapping sequentially the linguistic profiles of individual episodes in witness statements.

The first strategy, termed *Prolix and Personal*, is a verbose approach with high immediacy and ambiguity. In this strategy, deceivers are cooperatively vague; they are verbose yet subjective or non-committal. Statements make high use of First Person Singular Pronouns, where the deceiver is normally present (*I*) yet maintains degrees of non-immediacy through manipulation of *Me* and *My*.

The second strategy takes an *Impersonal* approach. Deceivers becoming increasingly *other* or *jointly* oriented, resulting in high use of Third Person or collective pronouns. Deceptive authors prefer to be absent, replacing *I* with *Me* or *My*. Ambiguity is not as high as in the *Prolix and Personal* strategy, as being impersonal achieves distancing by ascribing the action to others almost entirely, or diluting involvement by acting in concert with others.

Identification of linguistic strategies proves to be an effective discriminator between Truthful and Deceptive Statements, achieving an overall accuracy rate of 92%, and identifying 85% of Deceptive Statements, far more successful that Discriminant Analysis, which only identified 54% of Deceptive Statements and achieved an overall 64% accuracy.

7.3.2. Self-References and Deception

This study found that self-references, analysed individually for the first time, are not all weighted equally and not always associated with truth telling, challenging previous research findings on the traditional association between self-references and honesty. High levels of First Person Pronouns are strongly associated with deception, depending on the balance of individual pronouns within Statements. *My* proves to be the strongest individual deception discriminator of all the cues studied, a major finding previously unreported in deception research.

7.3.3. Narrative Fragmentation

Another result arising from the innovation of episode analysis is the finding that Deceptive Statements are more likely to fragment into many and smaller episodes. No previous study addresses this, although discourse research suggests some answers. Given that the marked sentences which function to signpost episode boundaries also serve as discontinuity markers, episodic fragmentation may signal a lack of cohesion between the events described; it may also arise from the fact that imagined events are not anchored in real time and place or to other real events in the narrative.

7.4. Difficulties and Limitations

There were three main difficulties associated with this study, which has resulted in limitations, here described.

First, there were difficulties obtaining suitable Statements for analysis. Surprisingly, it proved harder to obtain entirely truthful narratives involving serious consequence crime than Deceptive Statements. This resulted in the imbalance between Truthful and Deceptive

Statements in the Known Group, and its small sample size this in turn led to problems with overfitting in statistical analysis, most probably responsible for the low accuracy rate in identifying deception using Discriminant Function Analysis.

Collecting a larger test set would have much improved this study, but difficulties with obtaining author-written witness statements in the UK meant that they had to be sourced from the USA instead. Episode analysis was meant to compensate for the small test sample, but the identification by Logistic Regression analysis of only a single significant cue predictor for each measurement model (word and clause) meant that the predictions would likely not extend well to a wider population. Having said that, the 74% rate for correctly identifying Deceptive episodes using word count as a measurement means that the single cue (*Me*) does successfully identify deception at the episode level.

Additionally, there were difficulties with establishing the truth of information within Deceptive Statements in order compare Truthful and Deceptive episodes. This was addressed by applying a truth bias to the labelling of episodes in the Known Statements, and an even heavier truth bias to the unblinded episodes.

There was also the difficulty of establishing a baseline to which deceptive and truthful language could be compared. There is much literature which describes deceptive language, but little which describes truthful language. In the end, a decision was made to use the language found in Truthful Statements as the baseline against which to compare deceptive language.

Finally, this study sought to identify valid linguistic generalisations differentiating between truthful and deceptive witness statements written by American-English native speakers in the USA, irrespective of age, gender, education and social background. Therefore, the lack of sociolinguistic consideration is not considered a limitation in this study when applying the findings to US witness statements of the same vein. However, concentrating on American-English writers is a limitation of this study as it means that the findings cannot automatically be extended to other English variants, such as UK or Australian English speakers.

7.5. Implications of Findings

The implications of the findings in this study for deception research are potentially huge.

In the first instance, the view of deception as a progression has implications for the way deceptive language is analysed in the future. This view is not new. Burgoon & Qin (2008) and Zhou et al. (2004) have conducted studies on deception as a progression in interactive communication, but none have considered deception as a progression within individual communication. The success of strategy analysis hopefully will encourage researchers to adopt a progression view of deception, and consider the view that cues in interaction make better predictors than cues in combination or isolation.

For those investigating deception in a narrative context (which applies to verbal as well as textual deception), the use of episode analysis to deconstruct a storyline down into its constituent episodes also has enormous implications. Those who wish to subdivide a narrative into before, during, and after the event portions can now do it using the narrators' own linguistic signposting, instead of relying on analysts' subjective view of where the partitions lie. Episode partition provides an alternative to whole-statement analysis, allowing cues to be analysed on two levels. Furthermore, episode partition enables the mapping of linguistic cues in progression, without which identifying deceptive linguistic strategy at work would not be possible. Episode construction also has implications for the identification of deception by omission, given that new episode structures signal discontinuity in some form.

The finding of different weightings in roles between self-references, and the strong association between deception and *My* leads deception research in a new direction. No longer can it be assumed that First Person Pronouns are equally weighted or that they are automatically associated with truth telling. At least in the context of high stakes textual deception, this does not apply. What this study has not established is whether these findings are unique to the context of witness statements, or are a consequence of high stakes deception. This is something to be addressed by future research.

Equally important, this study raises a number of questions as to features regularly cited and addressed by deception research (including this one) in identifying cues. Two main issues arise, which are interrelated: first, is cue leakage as a result of emotional and cognitive burden valid for cue identification? Second, is Negation as an emotion leakage valid for cue identification? While deceivers did indeed use high levels of Negation in both Groups of Statements, so did several truthful authors. The success of this study in using cue interaction and strategy analysis to predict deception suggests that linguistic leakage plays little discernible part in textual deception, at least in the context of written witness statements. Cues such as Negation and Cognitive Verbs may serve to provide difficult-to-verify subjective information which pad out narratives, but it is only a small part of a wider strategy at work.

7.6. Contribution to Deception Research

This study fills a number of gaps in deception research. First, it examines high stakes lying in a real world context; second, it addresses an alternative view of deception as a progression; third, it takes an innovative approach to analysing deception using episode construction; and finally, it makes a material contribution to the increasing knowledge base of deceptive language in general, and textual narrative deception in particular.

This study makes no claim to having identified the Pinocchio's nose, or indeed, a unified theory of deception detection for which the deception detection world has been waiting. On the contrary, this study shows that deception is so complex, such a discovery appears unlikely. If the results of this study could be summed up in a single sentence, it is this – that the diagnostic value of individual cues is not static, but depends on their association and interaction with other cues. Evolution indeed favours the flexible liar.

REFERENCES

Adams, S.H. & Jarvis, J.P. (2006) Indicators of veracity and deception: an analysis of written statements made to police, *International Journal of Speech, Language and the Law*, 13 (1), 1-22.

Akehurst, L., Manton, S. & Quandte, S. (2011) Careful calculation or a leap of faith? A field study of the translation of CBCA ratings to final credibility judgements, *Applied Cognitive Psychology*, 25 (2), 236-243.

Anolli, L., Balconi, M. & Ciceri, R. (2002) Deceptive Miscommunication Theory (DeMiT): a new model for the analysis of deceptive communication. In Anolli, L., Ciceri, R. & Riva, G. (eds) *Say Not to Say: New Perspectives in Miscommunication,* 73-100. IOS Press.

Anolli, L., Balconi, M. & Ciceri, R. (2003) Linguistic styles in deceptive communication: dubitative ambiguity and elliptic eluding in packaged lies. *Social Behavior and Personality*, 31, 687-710.

Anolli, L. & Ciceri, R. (1997) The voice of deception: vocal strategies of naïve and able liars, *Journal of Non-Verbal Behavior*, 21, 259-284.

Argomon, A., Koppel, M., Fine, J. & Shimon, A.R. (2003) Gender, genre, and writing style in formal written texts, *Text – Interdisciplinary Journal for the Study of Discourse*, 23(3), 321-346.

Ashton, M.C., Lee, K. & Son, C. (2000) Honesty as the sixth factor of personality: correlations with Machiavellianism, primary psychopathy, and social adroitness, *European Journal of Personality*, 14, 359-368.

Barnes, R.D. & Ickes, W. (1979) Styles of self-monitoring: assimilative versus accommodative. Unpublished Manuscript. University of Wisconsin.

Barthes, R. (1996) An introduction to the structural analysis of narrative. In Onega, S. & Landa, J.A. (eds) *Narratology*. New York: Longman.

Baumeister, R.F. (1993) Lying to yourself: the enigma of self-deception. In Lewis, M. & Saarni, C. (eds) *Lying and Deception in Everyday Life*, 166-183. New York: The Guildford Press.

Baumeister, R.F., Bratslavsky, E., Muraven, M., & Tice, D. (1998) Ego-depletion: is the active self a limited resource? *Journal of Personality and Social Psychology*, *74*, 1252-1265.

Bell, C.M., McCarthy, P.M. & McNamara, D.S. (2006) variations in language use across gender: Biological versus sociological theories. In Sun, R. & Miyake, N. (eds) *Proceedings of the 28th Annual Conference of the Cognitive Science Society*. Mahwah, N.J.: Erlbaum.

Bestgen, Y. (1998) Segmentation markers as trace and signal of discourse structure, *Journal of Pragmatics*, 29, 753-763.

Bestgen, Y. & the Psycholinguistics Group of the *Spatial Framing Adverbials* Project (2009) The discourse function of sentence-initial adverbials: studies in comprehension, *Linguistic & Psycholinguistic Approaches to Text Structuring Conference*, 7-14. Paris, 21 – 23 September 2009.

Bestgen. Y. & Vonk, W. (2000) Temporal adverbials as segmentation markers in discourse comprehension, *Journal of Memory and Language*, 42, 74-87.

Biber, D. (1988) *Variation Across Speech and Writing*. Cambridge: Cambridge University Press.

Biber, D., Johansson, S, Leech, G, Conrad, S. & Finegan, E. (2000) *Longman Grammar of Spoken and Written English*. Longman

Blackmore, S. (1999) *The Meme Machine*, Oxford University Press.

Blackmore, S. (2008) Memes shape brains shape memes, *Behavioral and Brain Sciences*, 31(5), 513.

Bond, C.F. Jr. & DePaulo, B.M. (2006) Accuracy of deception judgements, *Personality and Social Psychology Review*, 10(3), 214-234.

Bond, C.F. Jr. & DePaulo, B.M. (2008) Individual differences in judging deception: accuracy and bias, *Psychological Bulletin*, 134(4), 477-492.

Bond, C.F. Jr., Kahler, K.N. & Paolicelli, L.M. (1985) The miscommunication of deception, *Journal of Experimental Social Psychology*, 21, 331-345.

Bond, G.D. & Lee, A.Y. (2005) Language of lies in prison: linguistic classification of prisoners' truthful and deceptive natural language, *Applied Cognitive Psychology*, 19, 313-329.

Bond Jr, C.F. & Robinson, M. (1988) The evolution of deception, *Journal of Nonverbal Behavior* 12(4), 295-307.

Brett, A.S., Phillips, M. & Beary, J.F. (1986) Predictive power of the polygraph: can the "lie detector" really predict liars? *The Lancet*, 1, 544-547.

Bruner, J. (1990) *Acts of Meaning*. Cambridge, MA: Harvard University Press.

Buller, D.B. & Burgoon, J.K. (1994) Deception: strategic and nonstrategic communications. In Daly, J.A. & Wieman, J.M. (eds), *Strategic Interpersonal Communication*, 191-223. New Jersey: Erlbaum.

Buller, D.B. & Burgoon, J.K. (1996) Interpersonal Deception Theory, *Communication*, 6, 203-242.

Buller, D.B., Comstock, J., Aune, R.K. & Strzyzewski, K.D. (1989) The effect of probing on deceivers and truthtellers, *Journal of Nonverbal Behavior*, 13, 155-170.

Buller, D.B., Strzyzewski, K.D. & Comstock, J. (1991) Interpersonal Deception 1: deceivers' reactions to receivers' suspicions and probing, *Communication Monographs*, 58, 1-24.

Buller, D.B., Strzyzewski, K.D. & Hunsaker, F.G. (1991) Interpersonal Deception 2: the inferiority of conversational participants as deception detectors, *Communication Monographs*, 58, 1-24.

Burgoon, J.K., Blair, J.P., Qin, T. & Nunamaker Jr, J.F. (2003) Detecting deception through linguistic analysis, *Proceedings of the Symposium on Intelligence and Security Informatics*. New York: Springer-Verlag.

Burgoon, J.K., Buller, D.B., Floyd, K. & Grandpre, J. (1996a) Deceptive realities: sender, receiver, and observer perspectives in deceptive conversations, *Communication Research*, 23, 724-748.

Burgoon, J.K., Buller, D.B., Guerrero, L.K., Afifi, W.A. & Feldman, C.M. (1996b) Interpersonal Deception: XII. Information management dimensions underlying truthful and deceptive messages. *Communication Monographs*, 63, 50-69.

Burgoon, J.K. & Qin, T. (2006) The dynamic nature of deceptive verbal communication, *Journal of Language and Social Psychology*, 25 (1), 76-96.

Burgoon, J.K., Stoner, G.M., Bonito, J.A. & Dunbar, N.E. (2003) Trust and deception in mediated communication, *Proceedings of the 36th Hawaii International Conference on System Sciences*.

Burgoon, J.K. & Qin, T. (2006) The dynamic nature of deceptive verbal communication, *Journal of Language and Social Psychology*, 25, 76-96.

Butterworth, B. (1978) Maxims for studying conversations, *Semiotica*, 24, 317-399.

Caldas-Coulthard, C.R. (1994) On reporting reporting: the representation of speech in factual and factional narrative. In Coulthard, M. (ed) *Advances in Written Text Analysis*. London: Routledge.

Campbell, R.S. & Pennebaker, J.W. (2003) The secret life of pronouns: flexibility in writing style and physical health, *Psychological Science*, 14(1), 60-65.

Carpenter, R.H. (1981) Stylistic analysis for law enforcement purposes: a case study of a language variable as an index of a suspect's caution in phrasing answers, *Communication Quarterly*, 29, 32-39.

Cheng, N., Chandramouli, R. & Subbalakshmi, K.P. (2011) Author identification from text, *Digital Investigation*, 8(1), 78-88.

Cody, M.J., Lee, W.S. & Chao, E.Y. (1989) Telling lies: correlates of deception among Chinese. In Forgas, J.P. & Innes, J.M. (eds) *Recent Advances in Social Psychology: An International Perspective*. The Netherlands: Elsevier.

Cody, M.J., Marston, P.J. & Foster, M. (1984) Deception: paralinguistics and verbal leakage. In Bostrom, R.N. & Westley, B.H. (eds) *Communication Yearbook 8*. California: Sage.

Cohen, E. (2010) *The Modulated Scream: Pain in late medieval culture.* Chicago; University of Chicago Press.

Colwell, K., Hiscock, C.K. & Memon, A. (2002) Interviewing techniques and the assessment of statement credibility, *Applied Cognitive Psychology*, 16, 287-300.

Colwell, K., Hiscock-Anismas, C., Memon, A., Rachel, A. & Colwell, L. (2007) Vividness and spontaneity of statement detail characteristics as predictors of witness credibility, *American Journal of Forensic Psychology*, 25(1), 5-30.

Coulthard, M. (1992) Forensic discourse analysis. In Coulthard, M. (ed) *Advances in Spoken Discourse Analysis*. London: Routledge.

Coulthard, M. (1999) Forensic applications of linguistic analysis. In Canter, D. & Alison, L. (eds) *Interviewing and Deception*. Aldershot, England: Ashgate Publishing Ltd.

Coulthard, M. & Johnson, A. (2007) *An Introduction to Forensic Linguistics: Language in Evidence*, Oxford: Routledge.

Danes, F. (1974) Functional sentence perspective and the text organization. In Danes, F. (ed.) *Papers on Functional Sentence Perspective*. Prague: Academia.

Darwin, C. (1859) The Origin of Species by Means of Natural Selection. In Encyclopaedia Britannica (1952) *Great Books of the Western World*. Chicago: William Benton.

Darwin, C. (1862) *The Various Contrivances by Which British and Foreign Orchids are Fertilized by Insects, and on the Good Effects of Intercrossing.* London: Murray.

Dawkins, R. (2006) *The Selfish Gene.* Oxford University Press (first published 1976).

Dawkins, R. & Krebs, J. R. (1978) Animal signals: information or manipulation? In Krebs, J.R. & Davies, N.B. (eds) *Behavioural Ecology: An Evolutionary Approach*. Oxford: Blackwell Scientific Publication.

Dawkins, R. & Krebs, J.R. (1979) Arms races between and within species. *Proceedings of the Royal Society of London, Series B, Biological Sciences*, 205(1161), 489-511.

DePaulo, B.M., Kashy, D.A., Kirkendol, S.E., Myer, M.M. & Epstein, J.A. (1996) Lying in everyday life, *Journal of Personality and Social Psychology*, 70, 979-995.

DePaulo, B.M., Kirkendol, S.E., Tang, J. & O'Brien, T.P. (1988) The Motivational Impairment Effect in the communication of deception: replications and extensions, *Journal of Human Behavior*, 12(3), 177-202.

DePaulo, B.M. & Kirkendol, S.E. (1989) The Motivational Impairment Effect in the communication of deception. In Yuille, J.C. (ed) *Credibility Assessment*. Netherlands Kluwer Academic.

DePaulo, B.M., Lindsay, J.J., Malone, B.E., Muhlenbruck, L., Charlton, K. & Cooper, H. (2003) Cues to deception, *Psychology Bulletin*, 129(1), 74-118.

DePaulo, B.M. & Pfeifer, R.L. (1986) On-the-job experience and skill at detecting Deception, *Journal of Applied Social Psychology*, 16, 249-267.

DePaulo, B., Rosenthal, R., Green C.R. & Rosenkrantz, J. (1982a) Diagnosing deceptive and mixed messages from verbal and nonverbal cues, *Journal of Experimental Social Psychology*, 18, 433-446.

DePaulo, B.M., Rosenthal, R., Rosenkrantz, J. & Green, C.R. (1982b) Actual and perceived cues to deception: a closer look at speech, *Basic and Applied Social Psychology*, 3, 291-312.

DePaulo, B.M., Stone, J.L., & Lassiter, G.D. (1985) Telling ingratiating lies: effects of target sex and target attractiveness on verbal and nonverbal deceptive success, *Journal of Personality and Social Psychology*, 48, 1191-1203.

Dilmon, R. (2009) Between thinking and speaking: linguistic tools for detecting fabrication, *Journal of Pragmatics*, 41, 1152-1170.

Dovidio, J.F., Brown, C.E., Heltman, K., Ellyson, S.L. & Keating, C.F. (1988) Power displays between women and men in discussions of gender-linked tasks: A multichannel study, *Journal of Personality and Social Psychology*, 55(4), 580-587.

Dulaney Jr, E.F. (1982) Changes in language behavior as a function of veracity, *Human Communication Research*, 9, 75-82.

Dunbar, N.E., Ramirez Jr., A., & Burgoon, J.K. (2003) The effects of participation on the ability to judge deceit, *Communication Reports*, 16(1), 23-33.

Ebesu. A.S. & Miller, M.D. (1994) Verbal and nonverbal behaviors as a function of deception type, *Journal of Language and Social psychology*, 13 (4), 418-442.

Ekman, P. & Friesen, W.V. (1969) Nonverbal leakage and clues to deception, *Psychiatry*, 32, 88-106.

Ekman, P. & O'Sullivan, M. (1991) Who can catch a liar? *American Psychologist*, 46, 913-20.

Fairclough, N. (1988) Discourse representation in media discourse, *Sociolinguistics*, 17, 125-139.

Firbas, J. (2006) *Functional Sentence Perspective in Written and Spoken Communication (Studies in English Language)*. Cambridge: Cambridge University Press.

Freud, S. (1901) Psychopathology of everyday life. In *The Standard Edition of the Complete Psychological Works of Sigmund Freud*, vol. VI, (2001). London: Vintage.

Freud, S. (1905). "A Case of Hysteria", "Three Essays on Sexuality" and other works. In *The Standard Edition of the Complete Psychological Works of Sigmund Freud*, VII (2001). London: Vintage.

Fries, P.H. (1995) A personal view of Theme. In Ghadessy, M. (ed) *Thematic Developments in English Texts*. London: Pinter.

Fuller, C.M., Biros, D.P. & Delen, D. (2008) Exploration of feature selection and advanced classification models for high-stakes deception detection, *Proceedings of the 41st Hawaii International Conference in System Sciences*, 80-87.

Fuller, C.M., Biros, D.P. & Wilson, R.L. (2009) Decision support for determining veracity via linguistic-based cues, *Decision Support Systems*, 46, 695-703.

Galasinski, D. (2000) *The Language of Deception: A Discourse Analytical Study*. California: Sage Publications.

Gill, A.J. & Oberlander, J (2002) Taking care of the linguistic features of extraversion, *Proceedings of the 24th Annual Conference of the Cognitive Science Society*, 363-368.

Gill, A. & Oberlander, J. (2003) Perception of e-mail personality at zero acquaintance: extraversion takes care of itself; neuroticism is a worry, *Proceedings of the 25th Annual Conference of the Cognitive Science Society*, 456-461.

Gilovich, T., Medvec, V.H & Savitsky, K. (1998) The Illusion of Transparency: biased assessments of other's ability to read one's emotional states, *Journal of Personality and Social Psychology*, 75(2), 332-346.

Graesser, A.C., Millis, K.K. & Zwaan, R.A. (1997) Discourse comprehension, *Annual Review of Psychology*, 48, 163-189.

Granhag, P.A. & Stromwall, L.A. (1999) Repeated interrogations: stretching the deception detection paradigm, *Expert Evidence*, 7, 163-174.

Grice, H.P. (1975) Logic and conversation. In Cole, P. & Morgan, J. (eds) *Syntax and Semantics: Speech Acts*, 3. New York: Academic Press.

Güzeldere, G., Nahmias, E. & Deaner, R.O. (2002) Darwin's Continuum and the building blocks of deception. In Bekoff, M., Allen, C. & Burghardt, G.M. (eds) *The Cognitive Animal: Empirical and Theoretical Perspectives on Animal Cognition*. MIT Press.

Halliday, M.A.K. (1967) Notes on transitivity and theme in English Part 1, *Journal of Linguistics* 3(1), 37-81.

Halliday, M.A.K. (1967) Notes on transitivity and theme in English Part 2, *Journal of Linguistics* 3(2), 199-244.

Halliday, M.A.K. (1968) Notes on transitivity and theme in English Part 3, *Journal of Linguistics* 4(2), 179-215.

Halliday, M.A.K. (1971) Linguistic function and literary style: an inquiry into the language of William Golding's The Inheritors. In Webster, J.J. (ed) *Linguistic Studies of Text and Discourse: Volume 2 (Collected Works of M.A.K. Halliday).* London: Continuum.

Halliday, M.A.K. (1973) *Explorations in the Function of Language (Explorations in Language Study)*. London: Hodder & Stoughton.

Halliday, M.A.K. (1993) Towards a language-based theory of learning, *Linguistics and Education*, 5, 93-116.

Halliday, M.A.K. (2003). On the architecture of human language. In Webster, J.J. (ed) *On Linguistics and Language: Volume 3 (Collected Works of M.A.K. Halliday).* London: Continuum.

Halliday, M.A.K. & Mathiessen, C. (2004) *An Introduction to Functional Grammar*, 3rd edition. London: Hodder Education.

Hancock, J.T., Curry, L.E., Goorha, S. & Woodworth, M.T. (2004) Lies in conversation: an examination of deception using automated linguistic analysis, *Proceedings of the 26th Annual Conference of the Cognitive Science Society*, 26, 534-540.

Hancock, J.T., Curry, L.E., Goorha, S. & Woodworth, M.T. (2005) Automated linguistic analysis of deceptive and truthful synchronous computer-mediated communication, *HICCS*, 1, 22c.

Hancock, J.T., Curry, L.E., Goorha, S. & Woodworth, M. (2008) On lying and being lied to: a linguistic analysis of deception in computer-mediated communication, *Discourse Processes*, 45, 1-23.

Hancock, J.T., Woodworth, M.T. & Goorha, S. (2010) See no evil: the effect of communication medium and motivation in deception detection, *Group Decision and Negotiation*, 19, 327-343.

Hartwig, M., Granhag, P.A., Stromwall, L.A. & Kronvist, O. (2006) Strategic use of evidence during police interviews: when training to detect deception works, *Law and Human Behavior*, 30, 603-619.

Hartwig, M., Granhag, P.A., Stromwall, L.A. & Vrij, A. (2002) Deception detection: effects of conversational involvement and probing, *Goteburg Psychological Reports*, 32(2), 1-12.

Hartwig, M., Granhag, P.A., Stromwall, L.A. & Vrij, A. (2005) Detecting deception via strategic disclosure of evidence, *Law and Human Behavior*, 29, 469-484.

Heydon, G. (2011) Are police organisations suspending their disbelief in Scientific Content Analysis (SCAN)?, *iIIRG Bulletin*, 1 (1), 6-7.

Hollien, H. (1990) *The Acoustics of Crime: The New Science of Forensic Phonetics*. Plenum: New York.

Horn, L (1984) Toward a new taxonomy for pragmatic inference: q-based and r-based implicature. In Schiffrin, D. (ed) *Meaning, Form, and Use in Context*. Washington: Georgetown University Press.

Horn, L. (2005) Implicature. In Horn, L. & Ward, G. (eds) *The Handbook of Pragmatics*. Blackwell Publishing.

Hubbell, A.P., Mitchell, M.M. & Gee, J.C. (2001) The relative effects of timing of suspicion and outcome involvement on biased message processing, *Communication Monographs*, 68, 115-132.

Ickes, W., Reidhead, S. & Patterson, M. (1986) Machiavellianism and Self-Monitoring: as different as “me” and “you”, *Social Cognition*, 4, 58-74.

Israel, M. (2004) The pragmatics of polarity. In Horn, L.R. & Ward, G. (eds) *The Handbook of Pragmatics*, Oxford: Blackwell Publishing Ltd.

Johnson, M.K., Foley, M.A., Suengas, A.G. & Raye, C.L. (1988) Phenomenal characteristics of memories for perceived and imagined autobiographical events, *Journal of Experimental Psychology: General*, 117(4), 371-376.

Johnson, M.K. & Raye, C.L. (1981) Reality Monitoring, *Psychological Review*, 88, 67-85.

Kassin, S.M. & Gudjonsson, G.H. (2004) The psychology of confessions: A review of the literature and issues, *Psychological Science in the Public Interest*, 5(2), 33-67.

Kassin, S.M., Meissner, C.A. & Norwick, R.J. (2005) “I’d know a false confession if I saw one”: A comparative study of college students and police investigators, *Law and Human Behavior*, 29(2), 211-227.

Kinnear, P.R. & Gray, C.D. (2008) *SPSS 15 made simple.* East Sussex: Psychology Press

Knapp, M.L. & Comadena, M.E. (1979) Telling it like it isn’t: a review of theory and research on deceptive communications, *Human Communication Research*, 5(3), 270-285.

Knapp, M.L., Hart, R.P. & Dennis, H.S. (1974) An exploration of deception as a communication construct, *Human Communication Research*, 1, 15-29.

Kuiken, D. (1981) Nonimmediate language style and inconsistency between private and expressed evaluations. *Journal of Experimental Social Psychology*, 17, 183-196.

Labov, W. (1972) *Language in the Inner City: Studies in the Black English Vernacular*. Philadelphia: University of Pennsylvania Press.

Labov, W. (1997) Some further steps in narrative analysis, *The Journal of Narrative and Life History*, 7, 395-415.

Labov, W. & Waletsky, J. (1967) Narrative analysis. In Helm, J. (ed.) *Essays on the Verbal and Visual Arts*. Seattle: University of Washington Press.

Lakoff, R. (1973) Language and Woman's Place*, Language in Society*, 2(1), 45-80.

Larcker, D.F. & Zakolyukina, A.A. (2010) Detecting deceptive discussions in conference calls, *Rock Center for Corporate Governance Working Paper No. 83*.
Leech, G.N. (1983) *Principles of Pragmatics*. London: Longman

Levine, T.R., Kim, R.K., Park, H.S. & Hughes, M. (2006) Deception detection accuracy is a predictable linear function of message veracity base-rate: a formal test of Park and Levine's Probability Model, *Communication Monographs,* 73(3), 243-260.

Levine, T.R., Lapinski, M.K., Banas, J., Wong, N.C.H., Hu, A.D.S., Endo, K., Anders, L.N. (2002). Self-construal, self and other Benefit, and the generation of deceptive messages. *Journal of Intercultural Communication Research,* 31(1), 29-47.

Levine, T.R. & McCornack, S.A. (1996) A critical analysis of the behavioral adaptation explanation of the Probing Effect, *Human Communication Research*, 22, 575-588.

Levine, T.R. & McCornack, S.A. (2001) Behavioral adaptation, confidence, and heuristic-based explanations of the Probing Effect, *Human Communication Research*, 27(4), 471-502.

Levine, T.R., Parks, H.S. & McCormack, S.A. (1999) Accuracy in detecting truth and lies: documenting the Veracity Effect, *Communication Monographs*, 66, 125-144.

Lewin, R. (1987) Do animals read minds, tell lies? *Science*, 238, 1350-1351.

Masip, J., Garrido, E. & Herrero, C. (2004) Defining deception, *Anales de Psicologia* 20(1), 147-171.

Martin, N.G. & Eyesenck, H. J. (1976) Genetic factors in sexual behaviour. In Eyesenck, H.J. (ed) *Sex and Personality*. University of Texas Press.

Martin, N. & Jardine R. (1986) Eyesenck's contribution to behaviour genetics. In Modgil, S. & Modgil, C. (eds) *Hans Eyesenck: Consensus and Controversy*. East Sussex: Falmer House.

Masip, J., Sporer, S.L., Garrido, E. & Herrero, C. (2005) The detection of deception with the Reality Monitoring approach: a review of the empirical evidence, *Psychology, Crime & Law*, 11(1), 99-122.

McCornack, S. A. (1992). Information Manipulation Theory. *Communication Monographs*, 59, 1-16.

McCornack, S.A. (1997) The generation of deceptive messages: laying the groundwork for a viable theory of interpersonal deception. In Greene, J.O. (ed) *Message Production: Advances in Communication Theory.* New Jersey: Erlbaum.

McCornack, S.A. & Parks, M.R. (1986) Deception Detection and Relationship Development: the other side of trust. In McLaughlin, M.L. (ed) *Communication Yearbook*, 9, Beverley Hills, California: Sage Publishing.

McEwen, S. & Prideaux, G.D. (1997) The development of marked structures to code episode boundaries, *Journal of the Canadian Association of Applied Linguistics,* 19, 49-59.

Mehl, M.R., Gosling, S.D. & Pennebaker, J.W. (2006) Personality in its natural habitat: manifestations and implicit folk theories of personality in daily life*, Journal of Personality and Social Psychology*, 90(5), 862-877.

Mehrabian, A. (1971). Nonverbal betrayal of feeling. *Journal of Experimental Research in Personality, 5*, 64-73.

Meissner, C.A. & Kassin, S.M. (2002) “He’s guilty!”: investigator bias in judgements of truth and deception, *Law and Human Behavior*, 26, 469-480.

Memon, A., Fraser, J., Colwell, K., Odinot, G. & Mastroberardino, S. (2010) Distinguishing truthful from invented accounts using Reality Monitoring criteria, *Legal and Criminological Psychology*, 15, 177-194.

Memon, A., Vrij, A. & Bull, R. (2003) *Psychology and Law* (Second Edition). Chichester: John Wiley & Sons.

Miller, G.R. & Stiff, J.B. (1993) *Deceptive Communication*. Newbury Park, CA: Sage Publications.

Milroy L. & Gordon, M. (2003) *Sociolinguistics: Method and Interpretation*. Oxford: Blackwell.

Mitchell, R.W. (1986) A framework for discussing deception. In Mitchell, R.W. & Thompson, N.S. (eds) *Deception: Perspectives on Human and Non-Human Deceit*. Albany: State University of New York Press.

Mulac, A. & Lundell, T.L. (1986) Linguistic contributors to the gender-linked language effect, *Journal of Language and Social Psychology,* 5, 81-101.

Mulac, A., Lundell, T.L. & Bradac, J.J. (1986) Male/female language differences and attributional consequences in public speaking situation: Towards an explanation of the gender-linked language effect, *Communication Monographs*, 53, 115-129.

Mulac, A. & Lundell, T.L. (1994) Effects of gender-linked language differences in adults’ written discourse: Multivariate tests of language effects, *Language and Communication,* 14, 299-309.

Mulac, A., Siebold, D. & Farris, J. (2000) Female and male managers’ and professionals’ criticism giving differences in language use and effects, *Journal of Language and Social Psychology*, 19, 389-416.

Mulac, A., Studley, L. B. & Blau, S. (1990) The gender-linked language effect in primary and secondary students' impromptu essays, *Sex Roles*, 23, 439-469.

Mulac, A., Wiemann, J.M., Widenmann, S.J. & Gibson, T.W. (1988) Male/female language differences and effects in same-sex and mixed-sex dyads: The gender-linked language effect, *Communication Monographs*, 55, 315-335.

Muraven, M., & Baumeister, R.F. (2000). Self-regulation and depletion of limited resources: does self-control resemble a muscle? *Psychological Bulletin, 126*, 247-259.

Nahari, G., Vrij, A. & Fisher, R.P. (2012) Does the truth come out in the writing? SCAN as a lie detection tool, *Law and Human Behaviour*, 36(1), 68-76.

Newman, M.L., Groom, C.J., Handelman, L.D. & Pennebaker, J.W. (2008) Gender differences in language use: An analysis of 14,000 text samples, *Discourse Processes*, 45, 211-236.

Newman, M.L., Pennebaker, J.W., Berry, D.S. & Richards, J.M. (2003) Lying words: predicting deception from linguistic styles, *Personality and Social Psychology Bulletin*, 29, 547-675.

Oberlander, J. & Gill, A.J. (2004) Individual differences and implicit language: personality, parts-of-speech and pervasiveness, *Proceedings of the 25th Annual Conference of the Cognitive Science Society*, 1035-1040.

Park, H.S., Levine, T.R., McCornack, S.A., Morrison, K. & Ferrara, M. (2002) How people really detect lies, *Communication Monograph*, 69(2), 144-157.

Pennebaker, J.W., Francis, M.E., & Booth, R.J. (2001) Linguistic Enquiry and Word Count, *LIWC*. New Jersey: Erlbaum.

Pennebaker, J.W. & King, L.A. (1999) Linguistic styles: language used as an individual difference, *Journal of Personality and Social Psychology*, 77, 1296-1312.

Pennebaker, J.W. & Lay, T.C. (2002) Language use and crisis: an analysis of Mayor Rudolph Giuliani's press conferences, *Journal of Research in Personality*, 36, 272-281.

Pennebaker, J.W., Mehl, Mr, & Niederhoffer, K.G. (2003) Psychological aspects of natural language use: our words, our selves, *Annual Review of Psychology*, 54, 547-577.

Poole, M.E. (1979) Social class, sex, and linguistic coding, *Language and Speech*, 22, 49-67.

Porter, S. & Brinke, L.t. (2010) The truth about lies: What works in detecting high-stakes deception? *Legal and Criminological Psychology*, 15, 57-75.

Porter, S. & Yuille, J.C. (1996) The language of deceit: an investigation of the verbal clues to deception in the interrogation context, *Law and Human Behavior*, 20(4) 443-458.

Prideaux, G.D. (1989) Text data as evidence for language processing principles: the grammar of ordered events, *Language Sciences*, 11(1), 27-42.

Prideaux, G. D. (2000) Discourse analysis and psycholinguistics: breaking down barriers. In Lommel, A. & Melby, A. (eds), *LACUS Forum, 26*, 1-16.

Prideaux, G. D., & Hogan, J.T. (1993) Markedness as a discourse management device: the role of alternative adverbial clause orders, *Word,* 44, 397-411.

Puscasu, G. & Mitkov, R. (2006) It *it* were *then*, then when was *it*? Establishing the anaphoric role of *then*, *Proceedings of the 5th Conference of Language Resource and Evaluation*. Genoa, Italy.

Rabon, D. (1996) *Investigative Discourse Analysis*. North Carolina: Carolina Academic Press.

Rudacille, W.C. (1994) *Identifying Lies in Disguise*. Iowa: Kendall Hunt Publishing Company.

Sapir, A. (1987) *Scientific Content Analysis*. Phoenix: Laboratory for Scientific Interrogation.

Savitsky, K. & Gilovitch, T. (2003) The Illusion of Transparency and the alleviation of speech anxiety, *Journal of Experimental Social Psychology*, 39, 618-625.

Schweitzer, M.E., Brodt, S.E. & Croson, R.T.A. (2002) Seeing and believing: visual access and the strategic use of deception, *The International Journal of Conflict Management*, 13, 258-275.

Schler, J., Koppel, M., Argamon, S. & Pennebaker, J. (2005) Effects of Age and Gender on Blogging. In 2006 Proceedings of AAAI Spring Symposium on Computational Approaches for Analyzing Weblogs.

Segal, E.M., Duchan, J.F. & Scott, P.J. (1991) The role of interclausal connectives in narrative structuring: evidence from adults' interpretation of simple stories. *Discourse Processes*, 14, 27-54.

Shuy, R. (1998) *The Language of Confession, Interrogation, and Deception*. London: Sage Publications.

Silverman, L. (2010) *Tortured Subjects: Pain, Truth, and the Body in Early Modern France*, Chicago; University of Chicago Press.

Smith, E.O. (1987) Deception and evolutionary biology, *Cultural Anthropology*, 2, 50-64.

Smith, N. (2001) *Reading Between the Lines: An Evaluation of the Scientific Content Analysis Technique (SCAN)*. London: UK Home Office, Research, Development, and Statistics Directorate.

Sporer, S.L. (1997) The less travelled road to truth: verbal cues in deception detection in accounts of fabricated and self-experienced events, *Applied Cognitive Psychology*, 11, 373-397.

Steller, M. (1989) Recent developments in statement analysis. In Yuille, J.C. (1989) *Credibility Assessment*. Deventer, The Netherlands: Kluwer.

Suengas, A.G. & Johnson, M.K. (1988) Qualitative effects of rehearsal on memories for perceived and imagined complex events, *Journal of Experimental Psychology : General*, 117(4), 377-389.

Svoboda, A. (2005) An ABC of Functional Sentence Perspective (Part 1): an e-learning text for the students of English. Opava. Available from http://web.iol.cz/alesvo/vyuka/An_ABC_of_FSP.pdf [Accessed 02 August 2012]

Talbot, M. (2007) *Duped: Can brain scans uncover lies*? [online], New America Foundation. Available from http://www.newamerica.net/node/8390 [Accessed 07 December 2010]

Tausczik, Y.R. & Pennebaker, J.W. (2010) The psychological meaning of words: LIWC and computerized text analysis methods, *Journal of Language and Social Psychology*, 29 (1), 24-54.

Taylor, P. (2005) *Linguistic Indicators of Deception: First Report*. Unpublished Report. Liverpool: Liverpool University.

Taylor, P., Tomblin, S., Conchie, S. & Menacere, T. (2011) *Linguistic indicators of deception in some cultures are indicators of truth in others*. Paper presented at the annual meeting of the American Psychology - Law Society / 4th International Congress of Psychology and Law. Florida, USA.

Toma, C.L. & Hancock, J.T. (2010) Reading between the lines: linguistic cues to deception in online dating profiles, Proceedings of the 2010 ACM conference on Computer Supported Cooperative Work, 5-8.

Toris, C. & DePaulo, B.M. (1985) Effects of actual deception and suspiciousness of deception on interpersonal perceptions, *Journal of Personality and Social Psychology*, 47, 1063-1073.

Undeutsch, U. (1967). Beurteilung der Glaubhaftigkeit von Aussagen [Veracity assessment of statements]. In Undeutsch, U. (ed), *Handbuch der Psychologie: Vol. 11. Forensische Psychologie,* p. 26–181. Gottingen, Germany: Hogrefe.

Valacich, J.S., Dennis, A.R. & Nunamaker, J.F. (1992) Group size and anonymity effects on computer-mediated idea generation, *Small Group Research*, 2(1), 49-73.

Vasek, M.E. (1986) Lying as a skill: the development of deception in children. In Mitchell, R.W. & Thompson, N.S. (eds) *Deception: Perspectives on Human and Non-Human Deceit*. Albany: State University of New York Press.

Villar, G., Arciuli, J. & Barsaglini, A. (2010) Can reduced use of pronouns during deceptive versus truthful speech be observed in a language other than English? *Proceedings of the 13th Australasian International Conference on Speech Science and Technology*. Melbourne, Australia.

Virtanen, T. (1992) *Discourse Functions of Adverbial Placement in English: Clause-initial adverbials of time and place in narratives and procedural place descriptions*. Abo: Abo Akademi University Press.

Virtanen, T. (2008) Adverbials of ‘Manner’ and ‘Manner Plus’ in written English: why initial placement? *SKY Journal of Linguistics,* 21, p 271-93.

Vrij, A. (2000) *Detecting Lies and Deceit: The psychology of lying and the implications for professional practice.* Chichester: John Wiley & Sons.

Vrij, A. (2005) Criteria Based Content Analysis: a qualitative review of the first 37 studies, *Psychology, Public Policy, and Law*, 11(1), 3-41.

Vrij, A. (2008) *Detecting Lies and Deceit: Pitfalls and Opportunities.* Chichester: John Wiley & Sons Ltd.

Vrij, A. & Akehurst, L. (1998) Verbal communication and credibility: Narrative validity assessment. In Menon, A., Vrij, A. & Bull, R. (eds) *Psychology and Law: Truthfulness, Accuracy and Credibility*. Maidenhead: McGraw Hill.

Vrij, A., Edward, K., Roberts, K.P. & Bull, R. (2000) Detecting deceit via analysis of verbal and nonverbal behavior, *Journal of Nonverbal Behavior*, 24, 239-264.

Vrij, A., Ennis, E, Farman, S. & Mann, S. (2010) People's perceptions of their truthful and deceptive interactions in daily life, *Open Access Journal of Forensic Psychology*, 2, 6-49.

Vrij, A., Fisher, R., Mann, S. & Leal, S. (2006) Detecting deception by manipulating cognitive load, *Trends in Cognitive Science*, 10(4), 141-142.

Vrij, A., Fisher, R., Mann, S. & Leal, S. (2008) A cognitive load approach to lie detection, *Journal of Investigative Psychology and Offender Profiling*, 5, 39-43.

Vrij, A. & Mann, S. (2005) Police use of nonverbal behavior as indicators of deception. In Riggio, R.E. & Feldman, R.S. (eds) *Applications of Nonverbal Communication*. Mahwah, NJ: Lawrence Erlbaum Associates.

Vrij, A., Mann, S., Fisher, R.P., Leal, S., Milne, R. & Bull, R. (2008) Increasing cognitive load to facilitate lie detection: the benefit of recalling an event in reverse order, *Law and Human Behavior*, 32, 253-265.

Vrij, A., Mann, S., Kristen, S. & Fisher, R.P. (2007) Cues to deception and ability to detect lies as a function of police interview styles, *Law and Human Behavior*, 31, 499-518.

Vrij, A., Mann, S., Leal, S. & Granhag, P.A. (2010) Getting into the mind of pairs of liars and truth tellers: an examination of their strategies, *The Open Criminology Journal*, 3, 17-22.

Vrij, A., Mann, S., Robbins, E. & Robinson, M. (2006) Police officers' ability to detect deception in high stakes situations and in repeated lie detection tests, *Applied Cognitive Psychology*, 20(6), 742-755.

Vrij, A., Semin, G.R. & Bull, (1996) Insight in behavior displayed during deception, *Human Communication Research*, 22, 544-562.

Wagner, H. & Pease, K. (1976) The verbal communication of inconsistency between attitudes held and attitudes expressed, *Journal of Personality*, 44, 1-15.

Wason, P.C. (1965) The contexts of plausible denial, *Journal of Verbal Learning and Verbal Behavior*, 4(1), p 7-11.

Weiner, M. & Mehrabian, A. (1968) *Language within Language: Immediacy, a Channel in Verbal Communication.* New York: Appleton Century Crofts.

White, C.H. & Burgoon, J.K. (2001) Adaptation and communicative design: patterns of interaction in truthful and deceptive conversation, *Human Communication Research*, 27, 9-37.

Wiley, R.H. (1983) The evolution of communication: information and manipulation. In Halliday, T.R. & Slater, P.J.B. (eds) *Animal Behavior* vol. 2: Communication. New York: W.H. Freeman.

Wilson, D. & Sperber, D. (2000) Truthfulness and Relevance, *UCL Working Papers in Linguistics*, 12, 215-254.

Wilson, D. & Sperber, D. (2002) Relevance Theory, *UCL Working Papers in Linguistics*, 14, 249-287.

Woodworth, M., Hancock, J. & Goorha, S. (2005) The Motivational Enhancement Effect: implications for our chosen modes of communication in the 21st century, *Proceedings of the 38th Hawaii International Conference on System Sciences*.

Wundt, W. (1900) *Völkerpsychologie. Eine Untersuchung der Entwicklungsgesetze von Sprache, Mythus und Sitte*. Leipzig: Kröner

Young, P.A., Eaves, L.J. & Eyesenck, H.J. (1980) Intergenerational stability and change in the cause of variation in personality. *Personality and Individual Differences*, 1, 35-55.

Zhou, L., Burgoon, J.K., Nunamaker Jr, J.F. & Twitchell, D. (2004b) Automating linguistic-based cues for detecting deception in text-based asynchronous computer-mediated communication, *Group Decisions and Negotiation*, 13, 81-106.

Zhou, L., Burgoon, J.K. & Twitchell, D.P. (2003b) A longitudinal analysis of language behavior of deception in email, In Chen, H., Moore, R., Zeng, D. & Leavitt, J. (eds) *Intelligence and Security Informatics*, 2665, 102-110.

Zhou, L., Burgoon, J.K., Twitchell, D.P., Qin, T. & Nunamaker, Jr., J.F. (2004c) A comparison of classification methods for predicting deception in computer-mediated communication, *Journal of Management Information Systems*, 20(4), 139-165.

Zhou, L., Burgoon, J.K., Zhang, D. & Nunamaker, J.F. (2004a) Language dominance in interpersonal deception in computer-mediated communication, *Computers in Human Behavior*, 20, 381-402.

Zhou, L. & Sung, Y. (2008) Cues to deception in online Chinese groups, *Proceedings of the 41st Hawaii International Conference on System Sciences*, 146-153.

Zhou, L., Twitchell, D.P., Qin, T., Burgoon, J.K. & Nunamaker Jr, J.F. (2003) An Exploratory Study into Deception Detection in Text-Based Computer-Mediated Communication, *Proceedings of the 36th Hawaii International Conference on System Sciences.*

Zhou, L. & Zhang, D. (2004) Can online behaviour unveil deceivers? An exploratory investigation of deception in instant messaging, *Proceedings of the 37th Hawaii International Conference on System Sciences.*

Zhou, L. & Zhang, D. (2006) A comparison of deceptive behavior in dyad and triadic group decision making in synchronous Computer-mediated communication, *Small Group Research*, 7(2), 140-164.

Zhou, L. & Zhang, D. (2007) Typing or messaging: modality effect on deception detection in computer-mediated communication, *Decision Support Systems*, 44, 188-201.

Zipf, G.K. (1849) *Human Behavior and the Principle of Least Effort*. Oxford: Addison-Wesley Press:

Zuckerman, M., DePaulo, B.M. & Rosenthal, R. (1981) Verbal and nonverbal communication of deception. In Berkowitz, I. (ed) *Advances in Experimental Social Psychology*, 14. New York: Academic Press.

Zwaan, R.A., Langston, M.C. & Graesser, A.C. (1995) The construction of situation models in narrative comprehension: An event-indexing model, *Psychological Science*, 6, 292-297.

APPENDIX 1

Logistic Regression Predictions (Group 1 - Episodes Word & Clause Analysis)

Episode	Actual Group	Word Count Predicted	Predicted Group	Clause Count Predicted	Predicted Group
1	1	.534	2*	.445	1
2	2	.686	2	.619	2
3	2	.758	2	.739	2
4	2	.367	1*	.299	1*
5	2	.675	2	.595	2
6	2	.817	2	.794	2
7	2	.639	2	.665	2
8	1	.458	1	.546	2*
9	1	.211	1	.233	1
10	1	.222	1	.251	1
11	1	.272	1	.219	1
12	2	.596	2	.642	2
13	2	.976	2	.791	2
14	2	.848	2	.841	2
15	2	.639	2	.937	2
16	2	.675	2	.845	2
17	2	.286	1*	.428	1*
18	2	.516	2	.668	2
19	1	.441	1	.275	1
20	1	.445	1	.571	2*
21	1	.931	2*	.925	2*
22	2	.321	1*	.483	1*
23	2	.556	2	.582	2
24	2	.358	1*	.343	1*
25	2	.712	2	.792	2
26	2	.205	1*	.372	1*
27	2	.365	1*	.473	1*
28	2	.407	1*	.490	1*
29	1	.466	1	.630	2*
30	1	.671	2*	.776	2*
31	1	.393	1	.407	1
32	1	.405	1	.445	1
33	1	.397	1	.536	2*
34	1	.319	1	.377	1
35	2	.409	1*	.483	1*
36	2	.475	1*	.682	2
37	2	.482	1*	.743	2
38	2	.600	2	.566	2
39	1	.657	2*	.574	2*
40	1	.367	1	.291	1
41	1	.507	2*	.607	2*
42	1	.366	1	.548	2*
43	1	.316	1	.294	1
44	1	.455	1	.464	1
45	1	.503	2*	.594	2*

46	1	.507	2*	.475	1
47	1	.403	1	.602	2*
48	1	.388	1	.561	2*
49	1	.614	2*	.748	2*
50	1	.183	1	.170	1
51	2	.512	2	.366	1*
52	1	.403	1	.459	1
53	2	.540	2	.319	1*
54	1	.375	1	.427	1
55	2	.344	1*	.244	1*
56	2	.509	2	.426	1*
57	1	.486	1	.379	1
58	1	.482	1	.530	2*
59	2	.650	2	.604	2
60	2	.668	2	.666	2
61	2	.739	2	.694	2
62	2	.734	2	.725	2
63	2	.518	2	.538	2
64	2	.609	2	.634	2
65	2	.698	2	.663	2
66	1	.323	1	.292	1
67	1	.541	2*	.435	1
68	2	.464	1*	.406	1*
69	1	.430	1	.314	1
70	2	.529	2	.419	1*
71	2	.654	2	.675	2
72	2	.466	1*	.362	1*
73	2	.992	2	.686	2
74	2	.486	1*	.615	2
75	2	.746	2	.758	2
76	2	.464	1*	.603	2
77	1	.490	1	.439	1
78	1	.702	2*	.505	2*
79	1	.719	2*	.447	1
80	1	.806	2*	.724	2*
81	1	.657	2*	.514	2*
82	2	.626	2	.575	2
83	2	.722	2	.645	2
84	2	.472	1*	.622	2
85	2	.469	1*	.555	2
86	2	.560	2	.522	2
87	2	.651	2	.730	2
88	2	.585	2	.554	2
89	2	.436	1*	.364	1*
90	1	.416	1	.403	1
91	1	.559	2*	.565	2*
92	1	.326	1	.128	1
93	1	.288	1	.271	1
94	1	.514	2*	.388	1
95	1	.312	1	.224	1
96	1	.403	1	.442	1
97	1	.355	1	.519	2*

98	1	.367	1	.277	1
99	2	.304	1*	.179	1*
100	2	.370	1*	.295	1*
101	2	.454	1*	.389	1*
102	1	.471	1	.526	2*
103	2	.423	1*	.436	1*
104	1	.304	1	.237	1
105	1	.367	1	.338	1
106	1	.367	1	.284	1
107	1	.318	1	.250	1
108	1	.205	1	.160	1
109	1	.459	1	.461	1
110	1	.362	1	.362	1

Truthful (1)/Deceptive (2)/*Misclassified Statements

APPENDIX 2

Logistic Regression Blind Predictions (Group 2 - Episodes Word & Clause Count)

Episode No.	Word Count Predicted	Predicted Group	Clause Count Predicted	Predicted Group
111	**.320**	**1**	**.246**	**1**
112	**.425**	**1**	**.344**	**1**
113	**.367**	**1**	**.263**	**1**
114	**.379**	**1**	**.455**	**1**
115	**.441**	**1**	**.406**	**1**
116	**.748**	**2**	**.777**	**2**
117*	.337	1	.633	2
118*	.411	1	.706	2
119	.651	2	.635	2
120*	.688	2	.387	1
121*	.957	2	.498	1
122	.645	2	.699	2
123	.807	2	.565	2
124	.556	2	.727	2
125	.723	2	.766	2
126	.401	1	.352	1
127*	.400	1	.534	2
128	.439	1	.391	1
129	.205	1	.160	1
130*	.305	1	.590	2
131	.157	1	.180	1
132	.367	1	.277	1
133*	**.459**	**1**	**.557**	**2**
134*	**.558**	**2**	**.412**	**1**
135	**.314**	**1**	**.309**	**1**
136	**.504**	**2**	**.651**	**2**
137	**.367**	**1**	**.283**	**1**
138	**.312**	**1**	**.283**	**1**
139	**.367**	**1**	**.322**	**1**
140	**.373**	**1**	**.378**	**1**
141	**.578**	**2**	**.672**	**2**
142	.302	1	.308	1
143	.579	2	.757	2
144*	.532	2	.496	1
145	.504	2	.645	2
146	.946	2	.973	2
147	.840	2	.595	2
148	.639	2	.650	2
149*	.393	1	.507	2
150*	.405	1	.781	2
151*	.510	2	.465	1
152*	.466	1	.580	2
153*	.469	1	.573	2
154*	.420	1	.748	2

155	.880	2	.635	2
156	.501	2	.700	2
157	.571	2	.600	2
158	.625	2	.725	2
159*	**.511**	**2**	**.496**	**1**
160*	**.521**	**2**	**.428**	**1**
161	**.615**	**2**	**.576**	**2**
162	**.976**	**2**	**.693**	**2**
163	**.844**	**2**	**.769**	**2**
164	**.702**	**2**	**.648**	**2**
165	**.873**	**2**	**.902**	**2**
166	**.655**	**2**	**.791**	**2**
167	**.800**	**2**	**.708**	**2**
168	**.795**	**2**	**.679**	**2**
169	**.771**	**2**	**.811**	**2**
170	**.695**	**2**	**.674**	**2**
171	**.328**	**1**	**.330**	**1**
172	**.864**	**2**	**.754**	**2**
173*	.472	1	.889	2
174	.401	1	.472	1
175	.384	1	.442	1
176*	.517	2	.326	1
177	.367	1	.291	1
178	.781	2	.632	2
179	**.736**	**2**	**.598**	**2**
180	**.311**	**1**	**.393**	**1**
181	**.824**	**2**	**.664**	**2**
182	**.379**	**1**	**.407**	**1**
183*	**.793**	**2**	**.387**	**1**
184*	**.815**	**2**	**.302**	**1**
185*	**.503**	**2**	**.454**	**1**
186	.349	1	.406	1
187*	.320	1	.545	2
188	.631	2	.698	2
189	.328	1	.493	1
190*	.580	2	.325	1
191	.229	1	.209	1
192	.511	2	.723	2
193*	.801	2	.299	1
194	.230	1	.145	1
195	.316	1	.407	1
196	.367	1	.277	1
197	.458	1	.425	1
198*	.472	1	.585	2
199	.488	1	.462	1
200	.567	2	.504	2
201	.724	2	.619	2
202*	.474	1	.560	2
203	.541	2	.579	2
204	.891	2	.534	2
205	.641	2	.601	2
206*	.547	2	.361	1

207*	.688	2	.803	2
208	.549	2	.648	2
209	.157	1	.180	1
210*	.589	2	.478	1
211	.418	1	.400	1
212*	.332	1	.646	2
213	.222	1	.150	1
214	**.465**	**1**	**.318**	**1**
215	**.447**	**1**	**.482**	**1**
216	**.472**	**1**	**.337**	**1**
217	**.681**	**2**	**.531**	**2**
218*	**.475**	**1**	**.610**	**2**
219*	**.436**	**1**	**.636**	**2**
220*	**.389**	**1**	**.638**	**2**
221*	**.720**	**2**	**.483**	**1**
222	**.378**	**1**	**.480**	**1**
223*	**.480**	**1**	**.725**	**2**
224	**.553**	**2**	**.706**	**2**
225	.540	2	.534	2
226	.638	2	.761	2
227*	.452	1	.827	2
228*	.427	1	.651	2
229	.563	2	.684	2
230*	.602	2	.446	1
231	.571	2	.843	2
232	.367	1	.236	1
233	.550	2	.626	2
234*	.647	2	.458	1
235*	.519	2	.464	1
236	.648	2	.800	2
237	.823	2	.964	2
238	.747	2	.921	2
239*	**.511**	**2**	**.471**	**1**
240*	**.816**	**2**	**.473**	**1**
241*	**.791**	**2**	**.195**	**1**
242	**.906**	**2**	**.817**	**2**
243	**.974**	**2**	**.979**	**2**
244	**.377**	**1**	**.414**	**1**
245*	**.635**	**2**	**.415**	**1**
246	**.930**	**2**	**.896**	**2**
247	**.941**	**2**	**.759**	**2**
248*	**.722**	**2**	**.465**	**1**
249	**.903**	**2**	**.592**	**2**
250	**.484**	**1**	**.469**	**1**
251	**.613**	**2**	**.514**	**2**
252*	**.669**	**2**	**.493**	**1**
253*	**.999**	**2**	**.338**	**1**
254*	.662	2	.385	1
255*	.382	1	.693	2
256	.785	2	.813	2
257*	.592	2	.398	1
258	.387	1	.292	1

259	.279	1	.264	1
260	**.270**	**1**	**.275**	**1**
261*	**.382**	**1**	**.525**	**2**
262*	**.575**	**2**	**.456**	**1**
263*	**.504**	**2**	**.482**	**1**
264*	**.370**	**1**	**.507**	**2**
265	**.566**	**2**	**.781**	**2**
266	**.542**	**2**	**.620**	**2**
267	**.567**	**2**	**.628**	**2**
268*	**.409**	**1**	**.755**	**2**
269	**.336**	**1**	**.352**	**1**
270*	**.606**	**2**	**.285**	**1**
271	**.267**	**1**	**.322**	**1**
272	.506	2	.555	2
273	.592	2	.590	2
274	.526	2	.620	2
275	.153	1	.397	1
276*	.487	1	.653	2
277*	.393	1	.640	2
278	.268	1	.468	1
279	.323	1	.338	1
280	.543	2	.578	2
281	.635	2	.687	2
282*	.485	1	.578	2
283	.666	2	.707	2
284	.908	2	.763	2
285*	.739*	2	.354	1
286	.774	2	.690	2
287	.703	2	.633	2
288*	.583	2	.297	1
289	.774	2	.803	2
290*	.724	2	.366	1
291	.647	2	.569	2
292	.832	2	.527	2
293*	.490	1	.741	2
294	.707	2	.820	2
295	.659	2	.661	2
296*	.412	1	.503	2
297	.872	2	.629	2
298	.369	1	.213	1
299	.349	1	.414	1
300	.665	2	.783	2
301	.504	2	.552	2
302*	.628	2	.495	1
303	.205	1	.160	1
304*	.712	2	.415	1
305	.825	2	.781	2
306*	.483	1	.552	2
307	.651	2	.606	2
308	.775	2	.739	2
309	**.607**	**2**	**.630**	**2**
310	**.678**	**2**	**.558**	**2**

311	**.807**	**2**	**.608**	**2**
312	**.840**	**2**	**.786**	**2**
313*	**.778**	**2**	**.393**	**1**
314	**.927**	**2**	**.729**	**2**
315	**.620**	**2**	**.541**	**2**
316	.367	1	.223	1
317*	.735	2	.402	1
318	.205	1	.160	1
319*	.308	1	.516	2
320	.604	2	.588	2
321*	.631	2	.405	1
322	.450	1	.264	1
323	.649	2	.739	2
324*	.897	2	.433	1
325	.900	2	.607	2
326	.769	2	.534	2
327	.540	2	.640	2
328	.328	1	.480	1
329*	.456	1	.508	2
330*	.554	2	.408	1
331	**.431**	**1**	**.459**	**1**
332*	**.394**	**1**	**.619**	**2**
333	**.901**	**2**	**.590**	**2**
334*	**.613**	**2**	**.427**	**1**
335*	**.569**	**2**	**.449**	**1**
336*	**.383**	**1**	**.534**	**2**
337	**.743**	**2**	**.639**	**2**
338	**.952**	**2**	**.624**	**2**
339	**.786**	**2**	**.534**	**2**
340	**.642**	**2**	**.940**	**2**
341	**.719**	**2**	**.502**	**2**
342	**.616**	**2**	**.605**	**2**
343	**.617**	**2**	**.693**	**2**
344	**.412**	**1**	**.423**	**1**
345*	**.508**	**2**	**.389**	**1**
346	.284	1	.207	1
347*	.392	1	.589	2
348	.720	2	.510	2
349	.639	2	.787	2
350*	.470	1	.538	2
351*	.751	2	.445	1
352*	.397	1	.587	2
353	.847	2	.661	2
354	.816	2	.729	2
355	.257	1	.231	1
356*	**.296**	**1**	**.574**	**2**
357*	**.360**	**1**	**.581**	**2**
358	**.542**	**2**	**.716**	**2**
359	**.811**	**2**	**.651**	**2**
360	**.613**	**2**	**.708**	**2**
361	**.855**	**2**	**.604**	**2**
362	**.762**	**2**	**.562**	**2**

363*	**.744**	**2**	**.233**	**1**
364	**.761**	**2**	**.610**	**2**
365	**.751**	**2**	**.693**	**2**
366	**.544**	**2**	**.585**	**2**
367	**.628**	**2**	**.537**	**2**
368*	**.402**	**1**	**.775**	**2**
369*	**.405**	**1**	**.781**	**2**
370*	**.448**	**1**	**.514**	**2**
371	**.519**	**2**	**.561**	**2**
372	**.468**	**1**	**.335**	**1**
373*	**.473**	**1**	**.747**	**2**
374	**.674**	**2**	**.659**	**2**
375	**.568**	**2**	**.613**	**2**
376	**.867**	**2**	**.584**	**2**
377	**.575**	**2**	**.851**	**2**
378	**.773**	**2**	**.768**	**2**
379	**.566**	**2**	**.574**	**2**
380	**.532**	**2**	**.561**	**2**
381	**.664**	**2**	**.626**	**2**
382	**.839**	**2**	**.696**	**2**
383	**.766**	**2**	**.632**	**2**
384	**.932**	**2**	**.587**	**2**
385	**.872**	**2**	**.629**	**2**
386	**.529**	**2**	**.828**	**2**
387	**.673**	**2**	**.823**	**2**
388	**.904**	**2**	**.751**	**2**
389	**.837**	**2**	**.775**	**2**
390*	**.365**	**1**	**.652**	**2**
391	**.634**	**2**	**.701**	**2**
392	**.683**	**2**	**.669**	**2**
393	**.264**	**1**	**.445**	**1**
394	**.534**	**2**	**.592**	**2**
395	**.769**	**2**	**.699**	**2**
396	**.976**	**2**	**.651**	**2**
397	**.534**	**2**	**.788**	**2**
398	**.272**	**1**	**.269**	**1**
399*	**.387**	**1**	**.556**	**2**
400*	**.397**	**1**	**.650**	**2**
401	**.798**	**2**	**.832**	**2**
402	**.615**	**2**	**.714**	**2**
403*	**.323**	**1**	**.518**	**2**
404	**.559**	**2**	**.513**	**2**
405	**.367**	**1**	**.217**	**1**
406	**.860**	**2**	**.820**	**2**
407	**.377**	**1**	**.447**	**1**
408	**.375**	**1**	**.395**	**1**
409	**.367**	**1**	**.236**	**1**
410	**.476**	**1**	**.452**	**1**
411	**.643**	**2**	**.716**	**2**
412*	**.397**	**1**	**.762**	**2**
413	**.600**	**2**	**.847**	**2**
414	**.668**	**2**	**.720**	**2**

415*	**.524**	**2**	**.483**	**1**
416	**.667**	**2**	**.624**	**2**
417	**.692**	**2**	**.610**	**2**
418	**.825**	**2**	**.861**	**2**
419	**.293**	**1**	**.250**	**1**
420	**.504**	**2**	**.654**	**2**
421	**.574**	**2**	**.726**	**2**
422	**.709**	**2**	**.921**	**2**
423*	**.575**	**2**	**.437**	**1**
424	**.766**	**2**	**.726**	**2**
425*	**.409**	**1**	**.766**	**2**
426	**.336**	**1**	**.495**	**1**
427	**.613**	**2**	**.910**	**2**
428*	**.585**	**2**	**.324**	**1**
429	**.573**	**2**	**.871**	**2**
430	**.510**	**2**	**.866**	**2**
431	**.406**	**1**	**.444**	**1**
432*	**.397**	**1**	**.587**	**2**
433*	**.402**	**1**	**.775**	**2**
434	**.668**	**2**	**.737**	**2**
435	**.701**	**2**	**.714**	**2**
436*	**.480**	**1**	**.612**	**2**
437	**.377**	**1**	**.331**	**1**
438	**.808**	**2**	**.871**	**2**
439	**.373**	**1**	**.362**	**1**
440	**.775**	**2**	**.665**	**2**
441	**.297**	**1**	**.240**	**1**
442*	**.583**	**2**	**.432**	**1**
443	**.265**	**1**	**.117**	**1**
444*	**.657**	**2**	**.434**	**1**
445*	**.561**	**2**	**.491**	**1**
446	**.856**	**2**	**.553**	**2**
447	**.171**	**1**	**.175**	**1**
448*	**.415**	**1**	**.532**	**2**
449	**.481**	**1**	**.345**	**1**
450	**.102**	**1**	**.197**	**1**
451	**.166**	**1**	**.220**	**1**
452	**.279**	**1**	**.213**	**1**
453	.367	1	.263	1
454	.424	1	.280	1
455*	.436	1	.692	2
456*	.469	1	.674	2
457*	.480	1	.783	2
458	.359	1	.445	1
459*	.464	1	.534	2
460*	.379	1	.794	2
461*	.440	1	.662	2
462	.367	1	.277	1
463*	**.469**	**1**	**.615**	**2**
464	**.515**	**2**	**.773**	**2**
465*	**.380**	**1**	**.665**	**2**
466*	**.387**	**1**	**.600**	**2**

467	.598	2	.542	2
468*	.371	1	.543	2
469	.367	1	.307	1
470*	.622	2	.494	1
471	.447	1	.466	1
472	.349	1	.477	1
473*	.421	1	.548	2
474	.609	2	.549	2
475	.562	2	.871	2
476	.502	2	.639	2
477	.586	2	.504	2
478	**.349**	**1**	**.354**	**1**
479*	**.547**	**2**	**.484**	**1**
480	**.542**	**2**	**.647**	**2**
481*	.408	1	.575	2
482*	.496	1	.579	2
483	**.367**	**1**	**.263**	**1**
484	**.367**	**1**	**.307**	**1**
485*	**.327**	**1**	**.550**	**2**
486	**.396**	**1**	**.300**	**1**
487	**.471**	**1**	**.458**	**1**
488*	**.668**	**2**	**.480**	**1**
489	**.406**	**1**	**.473**	**1**

Truthful (1)/Deceptive (2)/*Misclassified Statements

APPENDIX 3

Group 2 Episodes: Logistic Regression Blind Predictions Compared to Unblinded Category

Episode No.	Actual/Believed Status	Word Count Predicted	Predicted Group	Clause Count Predicted	Predicted Group
111	**1**	**.320**	**1**	**.246**	**1**
112	**1**	**.425**	**1**	**.344**	**1**
113	**1**	**.367**	**1**	**.263**	**1**
114	**1**	**.379**	**1**	**.455**	**1**
115	**1**	**.441**	**1**	**.406**	**1**
116	**1**	**.748**	**2**	**.777**	**2**
117	1	.337	1	.633	2
118	1	.411	1	.706	2
119	2	.651	2	.635	2
120	2	.688	2	.387	1
121	2	.957	2	.498	1
122	2	.645	2	.699	2
123	2	.807	2	.565	2
124	2	.556	2	.727	2
125	2	.723	2	.766	2
126	2	.401	1	.352	1
127	2	.400	1	.534	2
128	1	.439	1	.391	1
129	1	.205	1	.160	1
130	1	.305	1	.590	2
131	1	.157	1	.180	1
132	1	.367	1	.277	1
133	**1**	**.459**	**1**	**.557**	**2**
134	**1**	**.558**	**2**	**.412**	**1**
135	**1**	**.314**	**1**	**.309**	**1**
136	**2**	**.504**	**2**	**.651**	**2**
137	**1**	**.367**	**1**	**.283**	**1**
138	**1**	**.312**	**1**	**.283**	**1**
139	**1**	**.367**	**1**	**.322**	**1**
140	**1**	**.373**	**1**	**.378**	**1**
141	**1**	**.578**	**2**	**.672**	**2**
142	1	.302	1	.308	1
143	1	.579	2	.757	2
144	1	.532	2	.496	1
145	1	.504	2	.645	2
146	1	.946	2	.973	2
147	1	.840	2	.595	2
148	1	.639	2	.650	2
149	1	.393	1	.507	2
150	1	.405	1	.781	2
151	1	.510	2	.465	1
152	1	.466	1	.580	2
153	1	.469	1	.573	2
154	1	.420	1	.748	2

155	1	.880	2	.635	2
156	1	.501	2	.700	2
157	1	.571	2	.600	2
158	1	.625	2	.725	2
159	**2**	**.511**	**2**	**.496**	**1**
160	**2**	**.521**	**2**	**.428**	**1**
161	**2**	**.615**	**2**	**.576**	**2**
162	**2**	**.976**	**2**	**.693**	**2**
163	**2**	**.844**	**2**	**.769**	**2**
164	**2**	**.702**	**2**	**.648**	**2**
165	**2**	**.873**	**2**	**.902**	**2**
166	**2**	**.655**	**2**	**.791**	**2**
167	**2**	**.800**	**2**	**.708**	**2**
168	**2**	**.795**	**2**	**.679**	**2**
169	**2**	**.771**	**2**	**.811**	**2**
170	**2**	**.695**	**2**	**.674**	**2**
171	**2**	**.328**	**1**	**.330**	**1**
172	**2**	**.864**	**2**	**.754**	**2**
173	1	.472	1	.889	2
174	1	.401	1	.472	1
175	1	.384	1	.442	1
176	1	.517	2	.326	1
177	1	.367	1	.291	1
178	1	.781	2	.632	2
179	**2**	**.736**	**2**	**.598**	**2**
180	**2**	**.311**	**1**	**.393**	**1**
181	**2**	**.824**	**2**	**.664**	**2**
182	**2**	**.379**	**1**	**.407**	**1**
183	**2**	**.793**	**2**	**.387**	**1**
184	**2**	**.815**	**2**	**.302**	**1**
185	**2**	**.503**	**2**	**.454**	**1**
186	1	.349	1	.406	1
187	1	.320	1	.545	2
188	1	.631	2	.698	2
189	1	.328	1	.493	1
190	2	.580	2	.325	1
191	2	.229	1	.209	1
192	2	.511	2	.723	2
193	2	.801	2	.299	1
194	2	.230	1	.145	1
195	2	.316	1	.407	1
196	2	.367	1	.277	1
197	2	.458	1	.425	1
198	2	.472	1	.585	2
199	2	.488	1	.462	1
200	2	.567	2	.504	2
201	2	.724	2	.619	2
202	2	.474	1	.560	2
203	2	.541	2	.579	2
204	2	.891	2	.534	2
205	2	.641	2	.601	2
206	2	.547	2	.361	1

207	2	.688	2	.803	2
208	2	.549	2	.648	2
209	2	.157	1	.180	1
210	2	.589	2	.478	1
211	2	.418	1	.400	1
212	1	.332	1	.646	2
213	1	.222	1	.150	1
214	**1**	**.465**	**1**	**.318**	**1**
215	**1**	**.447**	**1**	**.482**	**1**
216	**1**	**.472**	**1**	**.337**	**1**
217	**1**	**.681**	**2**	**.531**	**2**
218	**1**	**.475**	**1**	**.610**	**2**
219	**1**	**.436**	**1**	**.636**	**2**
220	**1**	**.389**	**1**	**.638**	**2**
221	**1**	**.720**	**2**	**.483**	**1**
222	**1**	**.378**	**1**	**.480**	**1**
223	**1**	**.480**	**1**	**.725**	**2**
224	**1**	**.553**	**2**	**.706**	**2**
225	2	.540	2	.534	2
226	2	.638	2	.761	2
227	2	.452	1	.827	2
228	2	.427	1	.651	2
229	2	.563	2	.684	2
230	2	.602	2	.446	1
231	2	.571	2	.843	2
232	1	.367	1	.236	1
233	2	.550	2	.626	2
234	2	.647	2	.458	1
235	2	.519	2	.464	1
236	2	.648	2	.800	2
237	2	.823	2	.964	2
238	2	.747	2	.921	2
239	**2**	**.511**	**2**	**.471**	**1**
240	**2**	**.816**	**2**	**.473**	**1**
241	**2**	**.791**	**2**	**.195**	**1**
242	**2**	**.906**	**2**	**.817**	**2**
243	**2**	**.974**	**2**	**.979**	**2**
244	**2**	**.377**	**1**	**.414**	**1**
245	**2**	**.635**	**2**	**.415**	**1**
246	**2**	**.930**	**2**	**.896**	**2**
247	**2**	**.941**	**2**	**.759**	**2**
248	**2**	**.722**	**2**	**.465**	**1**
249	**2**	**.903**	**2**	**.592**	**2**
250	**2**	**.484**	**1**	**.469**	**1**
251	**2**	**.613**	**2**	**.514**	**2**
252	**2**	**.669**	**2**	**.493**	**1**
253	**1**	**.999**	**2**	**.338**	**1**
254	1	.662	2	.385	1
255	1	.382	1	.693	2
256	1	.785	2	.813	2
257	1	.592	2	.398	1
258	1	.387	1	.292	1

259	1	.279	1	.264	1
260	**1**	**.270**	**1**	**.275**	**1**
261	**1**	**.382**	**1**	**.525**	**2**
262	**1**	**.575**	**2**	**.456**	**1**
263	**1**	**.504**	**2**	**.482**	**1**
264	**1**	**.370**	**1**	**.507**	**2**
265	**1**	**.566**	**2**	**.781**	**2**
266	**1**	**.542**	**2**	**.620**	**2**
267	**1**	**.567**	**2**	**.628**	**2**
268	**1**	**.409**	**1**	**.755**	**2**
269	**1**	**.336**	**1**	**.352**	**1**
270	**1**	**.606**	**2**	**.285**	**1**
271	**1**	**.267**	**1**	**.322**	**1**
272	2	.506	2	.555	2
273	2	.592	2	.590	2
274	2	.526	2	.620	2
275	2	.153	1	.397	1
276	2	.487	1	.653	2
277	2	.393	1	.640	2
278	2	.268	1	.468	1
279	2	.323	1	.338	1
280	2	.543	2	.578	2
281	2	.635	2	.687	2
282	2	.485	1	.578	2
283	2	.666	2	.707	2
284	2	.908	2	.763	2
285	2	.739*	2	.354	1
286	2	.774	2	.690	2
287	2	.703	2	.633	2
288	2	.583	2	.297	1
289	2	.774	2	.803	2
290	2	.724	2	.366	1
291	2	.647	2	.569	2
292	2	.832	2	.527	2
293	2	.490	1	.741	2
294	2	.707	2	.820	2
295	2	.659	2	.661	2
296	1	.412	1	.503	2
297	1	.872	2	.629	2
298	1	.369	1	.213	1
299	1	.349	1	.414	1
300	2	.665	2	.783	2
301	1	.504	2	.552	2
302	1	.628	2	.495	1
303	1	.205	1	.160	1
304	2	.712	2	.415	1
305	2	.825	2	.781	2
306	1	.483	1	.552	2
307	1	.651	2	.606	2
308	2	.775	2	.739	2
309	**1**	**.607**	**2**	**.630**	**2**
310	**2**	**.678**	**2**	**.558**	**2**

311	**1**	**.807**	**2**	**.608**	**2**
312	**1**	**.840**	**2**	**.786**	**2**
313	**1**	**.778**	**2**	**.393**	**1**
314	**1**	**.927**	**2**	**.729**	**2**
315	**1**	**.620**	**2**	**.541**	**2**
316	1	.367	1	.223	1
317	1	.735	2	.402	1
318	1	.205	1	.160	1
319	1	.308	1	.516	2
320	2	.604	2	.588	2
321	2	.631	2	.405	1
322	2	.450	1	.264	1
323	2	.649	2	.739	2
324	2	.897	2	.433	1
325	2	.900	2	.607	2
326	2	.769	2	.534	2
327	2	.540	2	.640	2
328	1	.328	1	.480	1
329	1	.456	1	.508	2
330	1	.554	2	.408	1
331	**1**	**.431**	**1**	**.459**	**1**
332	**1**	**.394**	**1**	**.619**	**2**
333	**1**	**.901**	**2**	**.590**	**2**
334	**1**	**.613**	**2**	**.427**	**1**
335	**1**	**.569**	**2**	**.449**	**1**
336	**1**	**.383**	**1**	**.534**	**2**
337	**1**	**.743**	**2**	**.639**	**2**
338	**1**	**.952**	**2**	**.624**	**2**
339	**1**	**.786**	**2**	**.534**	**2**
340	**1**	**.642**	**2**	**.940**	**2**
341	**1**	**.719**	**2**	**.502**	**2**
342	**1**	**.616**	**2**	**.605**	**2**
343	**1**	**.617**	**2**	**.693**	**2**
344	**1**	**.412**	**1**	**.423**	**1**
345	**1**	**.508**	**2**	**.389**	**1**
346	1	.284	1	.207	1
347	1	.392	1	.589	2
348	1	.720	2	.510	2
349	1	.639	2	.787	2
350	1	.470	1	.538	2
351	1	.751	2	.445	1
352	1	.397	1	.587	2
353	1	.847	2	.661	2
354	1	.816	2	.729	2
355	1	.257	1	.231	1
453	1	.367	1	.263	1
454	1	.424	1	.280	1
455	1	.436	1	.692	2
456	1	.469	1	.674	2
457	1	.480	1	.783	2
458	1	.359	1	.445	1
459	1	.464	1	.534	2

460	1	.379	1	.794	2
461	1	.440	1	.662	2
462	1	.367	1	.277	1
463	**2**	**.469**	**1**	**.615**	**2**
464	**2**	**.515**	**2**	**.773**	**2**
465	**2**	**.380**	**1**	**.665**	**2**
466	**2**	**.387**	**1**	**.600**	**2**
467	1	.598	2	.542	2
468	1	.371	1	.543	2
469	1	.367	1	.307	1
470	1	.622	2	.494	1
471	1	.447	1	.466	1
472	1	.349	1	.477	1
473	1	.421	1	.548	2
474	1	.609	2	.549	2
475	1	.562	2	.871	2
476	1	.502	2	.639	2
477	1	.586	2	.504	2
478	**1**	**.349**	**1**	**.354**	**1**
479	**2**	**.547**	**2**	**.484**	**1**
480	**2**	**.542**	**2**	**.647**	**2**
481	2	.408	1	.575	2
482	2	.496	1	.579	2
483	**1**	**.367**	**1**	**.263**	**1**
484	**1**	**.367**	**1**	**.307**	**1**
485	**1**	**.327**	**1**	**.550**	**2**
486	**1**	**.396**	**1**	**.300**	**1**
487	**1**	**.471**	**1**	**.458**	**1**
488	**1**	**.668**	**2**	**.480**	**1**
489	**1**	**.406**	**1**	**.473**	**1**

Truthful (1)/Deceptive (2)