THE EFFECT OF COGNITIVE LOAD ON NONVERBAL MIMICRY IN INTERVIEW SETTINGS

by

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Declaration

I declare that the thesis is my own work, and has not been submitted in substantially the same form for the award of a higher degree elsewhere.

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21-03-2014

Collaborations

The text from Chapter 2 of this thesis overlaps with text from Poppe, R. W., Van Der Zee, S., Heylen, D. K. J., & Taylor, P. J (in press). AMAB: Automated Measurement and Analysis of Body Motion. *Behaviour Research Methods*.

Part of the data used in Chapter 6 of this thesis also appears in: Rotman, L. (2012). How culture influences the telling and detecting of lies: Differences between low- and high-context individuals. *Master Thesis*.

In addition to comments from my two supervisors, Prof. Paul Taylor and Dr. Lara Warmelink, the following Chapters have been commented on by other co-authors to prepare for publication:

- Chapter 5: Dr. Matthijs Noordzij and Dr. Ir. Ronald Poppe
- Chapter 6: Prof. Dr. Ellen Giebels and Lieke Rotman

Dedication

For Jouke and Jozien

Nature or Nurture

Or maybe a bit of both

This is for you

Abstract

Traditionally, studies of the nonverbal correlates of deception have focused on the change in interviewees' behaviour when lying and telling the truth. However, lying does not occur in isolation but during interaction, which is a fundamentally social and bidirectional process. The first half of this thesis explored whether or not interpersonal processes are affected by lying. Chapter 2 proposed an automatic approach for measuring the occurrence of nonverbal mimicry as an indicator of interpersonal processes. Chapter 3 used this automatic approach to examine the occurrence of mimicry when interviewees told truth and lies of increasing difficulty. Results showed that mimicry correlated positively with cognitive load. Chapter 4 described a study designed to rule out an alternative explanation, which is that it may have been a consequence of interviewees increasing their attention on nonverbal behaviour. A replication of Chapter 3 ruled out the attention explanation and confirmed the positive association between cognitive load and lie difficulty.

The second half of this thesis examined forensically relevant factors that may impact cognitive load. In response to the growing cultural diversity and language skills encountered in the interview room, Chapters 5 and 6 investigated the impact of second language use and cultural background on nonverbal mimicry. The Chapters demonstrated that cognitive load affects mimicry in interviews with first language speakers and with low-context individuals. However, the mimicry results in second language speakers were better explained by the interviewee's use of mimicry to enhance the interviewer's perception of their credibility. Chapter 7 extended the work of the previous two Chapters by considering the impact of interviewing style (accusatory vs. information gathering) on mimicry of interviewees from different cultures. The results revealed that a culture-dependent effect of interview style on

mimicry. Again, while the mimicry results of low-context individuals were best explained through cognitive load, the cross-cultural results were better explained through the interviewee's attempt to enhance their credibility, especially when interviewed in an accusatory manner. This thesis provides evidence that nonverbal mimicry differs between truth tellers and liars, but that this effect can be moderated by second language use, culture and interview style.

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Chapter One: **General Introduction**

The deception literature covers a wide range of methods for detecting deception, including attempts with (i.e. polygraph, EEG and fMRI; Spence et al., 2001; Verschuere, Ben-Shakar, & Meijer, 2011) and without (i.e. verbal and nonverbal cues; Vrij, 2008) the use of equipment. Unfortunately, people themselves are not very good at detecting deception. A meta-analysis on 206 experimental deception studies revealed an average correct detection rate of 54% (Bond & DePaulo, 2006). The stability of this average detection rate became apparent in an experiment where training people to detect lies led to higher confidence rates, but not better detection rates (Kassin & Fong, 1999). Even police personnel who have received training on detecting deceit and who likely encounter lying regularly, do not perform much better than lay people in experimental deception research, achieving an average detection rate of 55% (Vrij & Mann, 2005). However, these percentages may not accurately reflect detecting deception effectiveness during real police interviews, seen as the designs of deception experiments often do not reflect ecologically valid interview situations. For example, as opposed to real police interviews, experimental deception research often involves situations in which the interviewer does not interact with the interviewee, or when they do interact, have to follow scripts.

Vrij, Granhag and Porter (2010) have investigated why detecting lies is so difficult, and they identified a number of reasons, with one of the main reasons being the absence of a unique verbal or nonverbal cue related to deception, also called the equivalent of Pinocchio's growing nose (DePaulo, Lindsay, Malone, Muhlenbruck, Charlton, & Cooper, 2003; Vrij, 2008; Vrij et al., 2010). So far, no verbal, paraverbal or nonverbal behaviours that uniquely occur when lying have been identified (DePaulo et al., 2003; Sporer & Schwandt, 2006; Vrij, 2008; Zuckerman, DePaulo, &

Rosenthal, 1981). Importantly, meta-analyses on cues to deception revealed that the majority of cues that researchers thought were related to deceit and which they had subsequently measured in their deception experiments, were actually not related to deceit (about 75% of studied cues; e.g. gaze aversion and postural shifts; DePaulo et al., 2003; Vrij et al., 2010). Cues that were associated with deceit, were often only weakly correlated and had small effect sizes. In practice, this means that real-life differences between truth tellers and liars are more subtle and less clear than stated in police interview manuals and is believed by the common public (DePaulo et al., 2003; Vrij et al., 2008). Other difficulties are associated with the liar (e.g., liars attempting to appear credible, lies being embedded in true stories and skilfulness of some liars) or the lie detector (e.g., lack of adequate feedback; violation of normal conversation rules when attempting to detect deceit; Vrij, 2008; Vrij et al., 2010).

1.1 Nonverbal Cues to Deceit

For decades, people have been interested in behavioural differences between truth tellers and liars. The results of this research are summarized in several meta-analyses on cues to deception (Zuckerman et al., 1981; DePaulo et al., 2003, Vrij, 2008). These meta-analyses revealed several problems associated with the use of nonverbal cues to detect deceit, such as the non-existence of an equivalent to Pinocchio's growing nose, people's tendency to focus on the wrong cues and the cues that are related to deception, are often only weakly correlated to deception and typically have small effect sizes (DePaulo et al., 2003; Sporer & Schwandt, 2006; Vrij, 2008; Vrij et al., 2010; Zuckerman et al., 1981). For example, DePaulo et al. (2003), found that amongst nonverbal cues, only illustrators (movements that accompany or emphasize speech; d = -.14), general fidgeting (d =.16) and chin raising (d = .25) were significantly related to deception. Although not significant, arm (d = -

.17) and leg (d = -.09) movements, body animation (d = .11) and fidgeting with objects (d = -.12) were associated with similar effect sizes. Several facial expressions were also significantly related to deception, for example pressing of the lips (d = .16) and overall facial pleasantness (d = -.12). Interestingly, posture shifts (d = .05), general head (d = -.02) and hand movements (d = .00), nodding (d = .01), smiling (d = .00), eye contact (d = .01) and gaze aversion (d = .03) were not related to deception at all.

In response to the weak correlations between nonverbal behaviour and lying, researchers have sought to identify moderators of the saliency of the cues. Zuckerman et al. (1981), for example, argued that the type and magnitude of deceptive behaviour is dependent on three, originally four, factors: The extent to which liars experience arousal and emotions such as guilt, fear and delight (Ekman, 1989), the extent to which they experience cognitive load as a result of difficulties constructing and maintaining the lie (Vrij, 2008; Zuckerman et al., 1981), and how able they are to control their "lying behaviour" (DePaulo, Kirkendol, Tang, & O'Brien, 1988; p. 7-10). Each of these three factors has been found to influence a liar's behaviour in different and sometimes contradicting ways (Vrij, 2008; Zuckerman et al., 1981). Emotions like guilt and fear have been found to decrease the production of illustrator gestures (Ekman, 1988), but the increased physiological arousal caused by fear may increase the product of self-adaptors and fidgeting (Zuckerman et al., 1981). Similarly, compared to truth telling, the excitement experienced when lying has been shown to increase the occurrence of body movements, such as smiling and illustrators (Vrij, 2008).

The cognitive load factor relates to the fact that lying can be more cognitively demanding than truth telling, since liars have to formulate a lie whilst remembering

and suppressing the truth (DePaulo et al., 2003; Kassin & Gudjonsson, 2004; Vrij, 2008; Spence et al., 2001; Vrij et al., 2010). Whilst people who tell the truth believe their innocence will shine through, liars often do not take their credibility for granted (DePaulo et al., 2003; Kassin, 2005; Kassin & Gudjonsson, 2004). This will lead to an increase in control and monitoring of both their own and the interaction partner's behaviour, and as a consequence may lead to an increase in cognitive load (Buller & Burgoon, 1996; DePaulo et al., 1988; DePaulo et al., 2003; Kassin & Gudjonsson, 2004; Schweitzer, Brodt, & Croson, 2002). In addition, the avoidance of slip of the tongues and providing new leads can further increase cognitive load when lying (Vrij, 2008). Cognitive load has been found to increase gaze aversion, while reducing hand movement (Ekman & Friesen, 1972), overall body animation (Vrij, 2008) and eye blinks (Bagley & Manelis, 1979).

Behaviour control is based on the assumption that liars do not take their credibility for granted, leading them to avoid behaviours they associate with lying and trying to appear honest instead (Buller & Burgoon, 1996; Burgoon & Buller, 1994; Kassin & Gudjonsson, 2004; Hocking, Bauchner, Kaminski, & Miller, 1979). Which behaviours liars will attempt to control depends on several factors. In the attempted control context, perceived cues to deception are more relevant than actual cues to deception because liars will try to control those behaviours they believe to be related to deceit, regardless of their actual relation with deceit (Taylor & Hick, 2007). The common believe is that people move more when lying, which will lead to a reduction in overall movement in when a liar tries to appear honest (Akehurst & Vrij, 1999; Burgoon & Buller, 1994). However, several problems are associated with attempting to control one's behaviour; for instance the lack of movement can look unnatural and rigid and although someone can decide to stop talking, they cannot be silent

nonverbally (Vrij, 2008). Importantly, a liar's attempt to control his behaviour may not succeed; some behaviour is difficult to control, especially behaviours that occur automatically, such as facial expressions. For example, Bagley and Manelis (1979) examined the occurrence of eye blinks. Even when people were aware that their eye blinks were being monitored, increased cognitive load led them to blink less, suggesting that this behaviour was beyond their control.

These three approaches provide an explanation for the occurrence of an individual's nonverbal cues to deceit. However, these approaches can lead to different and sometimes contradicting behaviours (Akehurst & Vrij, 1999). As a consequence, both an increase and a decrease in specific behaviours can be a sign of lying (e.g. an increase in fidgeting can be caused by lie related nervousness, whilst a decrease in fidgeting can be due to increased cognitive load or attempted behavioural control). Without knowing someone's baseline truthful and lying behaviour, and specific lie characteristics, it is very difficult to detect deceit solely based on the liar's behaviour.

Fortunately, lying does not occur in isolation. Although lying is part of everyday communication (DePaulo & Kashy, 1998; DePaulo, Kashy, Kirkendol, Wyer, & Epstein, 1996), it is rarely studied as a communicative activity (Buller & Burgoon, 1996). As with all interpersonal processes, lying occurs in a context where both interactants affect each other's behaviour (Burgoon, Buller, White, Afifi, & Buslig, 1999; Chartrand & Van Baaren, 2009; Garrod & Pickering, 2004). Rather than solely focussing on the behaviour of the liar, deception research would benefit from examining the interpersonal aspects of lying. This dyadic approach provides the opportunity to study not just the target behaviour, but also allows investigating behaviours that preceded and followed. This will provide an insight in direct causes and consequences of lying behaviour. Although taking a dyadic approach is relatively

unusual in deception research, this is standard practice in the human interaction literature.

In the deception literature this reality is best captured within Interpersonal Deception Theory (IDT, Buller & Burgoon, 1996). The IDT explains how lying or the perception of lying affects interpersonal processes in face-to-face communication. The theory relies on the three factors (emotional approach, cognitive load approach and the behavioural control approach) proposed by Zuckerman et al. (1981) as the underlying reasons for the occurrence of cues to deceit. Buller and Burgoon (1996) perceive a deceptive interaction as a bidirectional process in which lying can cause cues to deceit in the sender that may become apparent to the receiver through changes in verbal and/or nonverbal behaviour. The occurrence of cues to deceit in the sender can consciously or unconsciously change the perception, attitude and behaviour of the receiver, which may subsequently affect the behaviour of the sender and so on. According to the IDT, a dynamic approach in which both interactants mutually influence each other is required to fully understand deception. They propose that interactants affect each other on both an indirect and direct level. At the indirect level, people may adjust their behaviour based on their interaction partner's responses to previous statements or behaviour (Burgoon et al., 1999). For example, a receiver may become suspicious when being lied to and verbally or nonverbally communicate these doubts to the liar. This may cause the liar to try harder to convince the interviewer by adjusting their story and behaviour to appear more honest. Interpersonal communication is often goal-directed, and exists of both strategic behaviours that senders are usually aware of, and nonstrategic behaviours that often occur unintentionally (Buller & Bugoon, 1996). The latter can reflect someone's current emotional and cognitive state and the occurrence of these 'leakage cues' has been

studied as a strategy to detect deception (Porter & Ten Brinke, 2008). However, these strategic and nonstrategic behaviours are especially interesting in an interpersonal setting because people have the tendency to match the behaviours of their interaction partner (Burgoon et al., 1999). According to the IDT, by matching behaviours of the interaction partner, people influence each other at a direct level. Copying an interaction partner's postures, gestures and mannerisms simultaneously or within a few seconds is termed nonverbal mimicry (Chartrand & Lakin, 2013; Lakin, Jefferis, Cheng, & Chartrand, 2003; Stel, Van Dijk, & Olivier, 2009).

1.2 Nonverbal Mimicry

People have the tendency to imitate the behaviours of others, even when they do not know each other (Chartrand & Bargh, 1999). This tendency is commonly referred to in the literature as mimicry, and exists of mood contagion (i.e., emotional mimicry; Hatfield, Cacioppo, & Rapson, 1993; Stel, Van Baaren, & Vonk, 2008), the copying of one's facial expressions such as smiling (i.e., facial mimicry; Chartrand & Bargh, 1999), copying speech aspects such word use (i.e., verbal mimicry; Gonzales, Hancock, & Pennebaker, 2010) and copying one's mannerisms, postures and gestures (i.e., nonverbal mimicry; Bernieri, 1988). The focus in this thesis lies on nonverbal mimicry, including all behaviours that can be measured with motion tracking equipment. Motion tracking equipment is a device that can automatically record movement and create a numerical representation of this movement (for a detailed description and a table with examples, see Chapter 2). Importantly, mimicry is distinct from imitation in their level of awareness and deliberateness. Where mimicry usually occurs automatically and outside people's awareness (Bargh & Chartrand, 1999), imitation often is conscious and facilitates learning and social navigation (Bandura, 1962; Chartrand & Van Baaren, 2009).

The occurrence of mimicry has been shown to be beneficial for communication in social interactions. Its occurrence increases rapport, empathy and liking towards the interaction partner, with smoother interactions as a result (Chartrand & Bargh, 1999; Chartrand & Van Baaren, 2009; Lakin & Chartrand, 2003). Additionally, mimicry can increase people's pro-social orientation in general (Van Baaren, Holland, Kawakami & Van Knippenberg, 2004), and may consequently impact behaviour (Van Baaren, Holland, Steenaert & Van Knippenberg, 2003a). For example, in a study by Van Baaren et al. (2004), participants were invited to give their opinion about 10 advertisements. During this task, half of the participants were mimicked by the experimenter and half were not. Participants whose behaviour was mimicked by the experimenter were later on more likely to help her pick up some dropped pens, than participants who were not mimicked. Follow-up studies showed that participants also had this pro-social orientation when a third, unrelated person dropped the pens, and when the activity involved donating money, rather than picking up pens from the floor. However, there are limits to how much people can manipulate their mimicking behaviour before it has negative consequences. In their study, Leander, Chartrand and Bargh (2012) found that an inappropriate amount of mimicry made their participants feel emotionally cold.

Although mimicry can be consciously used to increase positive feelings and even change an interactant's behaviour, most mimicry takes place unconsciously (Bargh & Chartrand, 1999; Chartrand & Van Baaren, 2009). The automatic seeing-is-doing tendency is described by Chartrand and Bargh (1999) as a two-step perception-behaviour link. The first step involves the transmission from environment to perception by automatically categorizing and interpreting behaviour. This perceptual activation subsequently activates corresponding behavioural representations, creating

an automatic link between perception and behaviour. In other words, observing specific behaviours automatically increases the likelihood of displaying similar behaviour oneself. An example of the automaticity of mimicry is Chartrand and Bargh's (1999) demonstration that participants, outside of their awareness, mimicked the foot rubbing or face touching behaviour of the confederate with whom they were collaborating (Chartrand & Bargh, 1999). Importantly, some degree of mimicry occurs in most social interactions, even when people are distracted or preoccupied with other tasks (Chartrand & Lakin, 2013).

Observing changes in interpersonal processes when telling truths and lies is interesting for three reasons. First in general, Akehurst and Vrij (1999) showed how mimicry occurrence can impact interview suspicion. In their study, the amount of movement interviewers showed was manipulated. When the interviewer moved more, suspects moved more as well. In a follow-up experiment, suspects in the high interviewer movement condition were perceived to be more suspicious than participants in the low interviewer movement condition. This study highlights the importance of taking interpersonal processes into account when detecting deception. Second, as described above, lying does not occur in isolation. Therefore, taking a dynamic and interpersonal approach to deception will provide a more complete account of the effects of lying on nonverbal behaviour. Third, particularly the automatic aspect of mimicry is interesting from a deception point of view because people's attempt to control their lying behaviour is one of the main obstacles in the search for universal nonverbal cues to deception (Vrij, 2008). If lying affects interpersonal processes, measuring nonverbal mimicry between interactants when telling truths and lies will provide information about the possibility of using mimicry as a cue to deceit. Because mimicry involves a minimum of two people and mimicry

occurrence reveals how well those people match each other's behaviours, it will circumvent to some extent issues with inter-personal variations in nonverbal cues.

1.3 Nonverbal Changes vs. Automatic Process

The three theoretical approaches described above explain that behavioural differences between telling truths and lies are caused by emotions, cognitive load, and attempted behaviour control (Zuckerman et al., 1981). Although these theories provide a useful insight into how lying can impact a liar's behaviour, they do not explain how the changes in a liar's behaviour may impact interpersonal processes. Even IDT, which built upon these theories and stressed how directly, via adaptations in mimicry, and indirectly, via feedback from the receiver, lying can impact interpersonal processes, does not make specific predictions about how such mimicry may be affected.

One exception is Dunbar, Jensen and Burgoon (2011), who experimentally tested the impact of lying on nonverbal mimicry, or synchrony in their case. Their mimicry measure was obtained by manually coding videos. They invited participants to play a game with a confederate and were subsequently interviewed by a skilled interviewer about their experiences. During this game, one group of participants cheated and got caught (i.e., sanctioned liars), one group cheated but did no get caught (i.e., unsanctioned liars) and one group did not cheat whilst playing the game. Results indicated that regardless of veracity, most mimicry occurred during background questioning, followed by suspicion questioning and direct accusation. Interestingly, only during the direct accusation part of the interview, unsanctioned liars mimicked more than truth tellers. Their explanation for this effect is based on the indirect effect interactions partners may have on each other when lying, as was described by the IDT (Buller & Burgoon, 1996). Liars monitor the receiver for signs of suspicion and adapt

their behaviour to enhance their credibility when necessary. During the accusatory part of the interview, most signs of suspicion were likely to occur. In order to decrease the interviewer's suspicion, liars mimicked more during the accusatory interview part than truth tellers. Although these findings are interesting, they are inconclusive. For example, they did not counterbalance the different interview parts, meaning that the accusatory part always happened last. This order effect may have distorted the results, because mimicry develops over time. However, the combination of the IDT and the experiment conducted by Dunbar et al. (2011) suggests that interpersonal processes are affected by lying.

How may mimicry further be affected by lying? As reviewed above, all three theoretical perspectives propose behavioural changes when lying (Vrij, 2008; Zuckerman et al., 1981), and these changes may be predicted to have an impact on interpersonal processes. Emotions are likely to increase movements like fidgeting, whilst being cognitively loaded and attempting to control one's behaviour is likely to reduce movement (Burgoon & Buller, 1994; Ekman, 1988; Ekman & Friesen, 1972; Vrij, 2008). Regardless of the direction of affected movement, the behavioural changes will only occur in the liar and not in the receiver, creating a mismatch in movement between liar and receiver. This movement discrepancy is an example of how lying may directly impact interpersonal processes. Burgoon and Buller (1994) tested the indirect effects of lying and specifically behavioural control on the receiver's perceptions and subsequently on the interaction dynamics. They found that liars indeed controlled their behaviour by becoming more formal, restrained and tense, which disrupted interaction patterns and led the receiver to judge liars more negatively than truth tellers. Both a movement discrepancy created by behavioural changes when lying and disrupted interaction patterns caused by suspicious receivers

and negative feelings caused by being lied to, could lead to a decrease in nonverbal mimicry when lying.

On the contrary, the automatic aspect of mimicry suggests coordination may increase when someone is lying. Experimental research on behavioural influences of automatic processes has revealed that especially when cognitive resources are low, automatic processes become more important (Hofmann, Rauch, & Gawronski, 2007; Van Leeuwen, Van Baaren, Martin, Dijksterhuis, & Bekkering, 2009). It was revealed that mimicry increases under greater cognitive load through a study in which finger movements cued by finger movements or spatial cues were examined (Van Leeuwen et al., 2009). Only when under high cognitive load, induced by simultaneously performing other tasks, participants moved their finger quicker in response to the finger movement than the spatial cue. This automatic seeing-is-doing tendency is an example of the two-step perception-behaviour link, which forms the basis of human mimicry (Chartrand & Bargh, 1999). Further evidence for increased importance of automatic processes when cognitively loaded was provided by Hofmann et al. (2007), who manipulated self-regulation resources to investigate the influence of depletion on eating behaviour. Results revealed that while dietary restraints predicted candy consumption under highly available cognitive resources, people's more automatic attitudes were a better predictor when few resources were available. Automatic attitudes are spontaneous evaluations based on associative processes that spread activation and are useful when spontaneously deciding to approach or avoid stimuli (Hofmann et al., 2007). In other words, implicit attitude measures have an impact on automatic behaviour. Evidence that supports this statement was provided by Neumann, Hülsenbeck and Seibt (2004), who revealed that people's automatic attitudes (measured with the Implicit Association Test) towards AIDS patients

predicted their impulsive tendency to approach or avoid such patients. Hofmann et al. (2007) built further upon this automatic attitude theory by showing that especially when depleted, automatic attitudes, rather than conscious attitudes, predict behaviour best.

Various experiments have revealed that lying usually is more cognitively demanding than truth telling for several reasons (Cheng & Broadhurst, 2005; DePaulo et al., 2003; Vrij, 2008; Vrij et al., 2010). If people mimic more when cognitively loaded and lying increases load, it is expected that people mimic more when lying compared to when telling the truth.

1.4 Factors of Importance to Mimicry in a Deceptive Setting

Although nonverbal mimicry is often automatic, it nevertheless remains the case that various individual and contextual factors can impact its occurrence (Chartrand & Lakin, 2013). For example, having an interdependent self-construal and being empathic to the other party has been shown to be positively correlated with mimicry (Chartrand & Bargh, 1999; Sonnby-Borgström, 2002; Van Baaren, Maddux, Chartrand, de Bouter, & Van Knippenberg, 2003b). The same is true for familiarity, with mimicry increasing when the actors know one another and increasing still further when the actors like one other (McIntosh, 2006). Additionally, people mimic in-group members more than out-group members (Yabar, Johnston, Miles, & Peace, 2006), mimic people more with whom they share a goal (Lakin & Chartrand, 2003) and who are or think similar to themselves (Guéguen & Martin, 2009).

The following sections discuss some of the key contextual moderators of mimicry and how they play appear within the deception environment.

1.4.1 Attention.

Mimicry has been shown to occur even when people are not paying attention to the interactant or when they are preoccupied with other tasks (Chartrand & Lakin, 2013). Van Leeuwen et al. (2009) demonstrated that full attention is not only unnecessary for mimicry to occur; rather, being cognitively loaded by performing additional tasks can increase nonverbal mimicry. However, that mimicry occurs regardless of attention does not exclude a possible beneficial effect of attention on mimicry. Rather, the phenomenon that attention can increase mimicry has been demonstrated in relation to facial mimicry (Likowski, Muhlberger, Seibt, Pauli, & Weyers, 2008). The impact that attention can have on mimicry is particularly relevant to the deception setting, since liars may deliberately increase the degree to which they attend to the judge's behaviours in an effort to gauge the extent to which their lie is being believed (Schweitzer et al., 2002). The same is true of receivers who are aware that their role is to identifying deception. Their attention will likely increase because people have been found to pay more attention to negative events, such as lying, over neutral and positive events (Bok, 1978; Dijksterhuis & Aarts, 2003; McCornack & Levine, 1990). It may therefore be the case that this shift in attention is responsible for changes in the extent of mimicry shown by liars and their interviewers.

1.4.2 Language.

Police forces increasingly need to interact with interviewees from diverse cultural backgrounds and they encounter a range of first languages in the interview room. Second language use has been shown to affect interviewing processes, where interviewers perceive second language speakers to be more deceptive regardless of veracity than first language speakers (Cheng & Broadhurst, 2005; Da Silva & Leach, 2011). This lie bias towards second language speakers may impact on the

interpersonal processes via the indirect route of the IDT, which proposes that suspicion displayed by the interviewer can cause a liar to change their behaviour to appear more honest. If second language speakers, regardless of veracity, are more often perceived to be suspicious by interviewers, this indirect effect may occur in deceptive second language interviews as well as truthful interactions.

More directly, second language can impact interpersonal processes by affecting nonverbal mimicry. An interview being performed in an interviewee's second language is likely to impact mimicry in two ways, since second language use is associated with both an increase in cognitive load (Cheng & Broadhurst, 2005) and 'foreign language anxiety' (Caldwell-Harris & Aycicegi-Dinn, 2009; Horwitz, Horwitz, & Cope, 1986). In general, both factors have been shown to impact nonverbal behaviour regardless of veracity. Studies of deception in relation to cognitive load have revealed that increased load reduces eye blinks (Bagley & Manelis, 1979) and hand movement (Ekman & Friesen, 1972), leading to an overall reduction in bodily animation (Vrij, 2008). Second language anxiety has shown to cause an increase in self-manipulators, averted eye gaze and nervousness (Gregersen, 2005).

This leads to two opposed predictions. On the one hand, the behavioural consequences of both factors could lead to a mismatch in behaviour between the interviewer and interviewee because the behavioural changes will only occur in the interviewee, whilst the interviewer's behaviour is likely to remain unaffected. This behavioural mismatch could reduce interviewer-interviewee mimicry. On the other hand, increased cognitive load when speaking in a second language compared to first language use (Cheng & Broadhurst, 2005) might increase interactional mimicry via the cognitive load route.

1.4.3 Culture.

These cross-cultural interactions may not only affect interactional processes through differences in language use, but also via culture-determined behaviour and attitudes. That culture affects behaviour in a deceptive context was shown in a study by Vrij and Winkel (1991). They showed that even when being truthful, Surinamese participants naturally showed more behaviours that are related to deception (e.g. gaze aversion, speech disturbances and higher tone pitch) compared to Dutch participants. In addition, Vrij and Winkel (1994) found that Dutch police officers tended to rate interviewees as more suspicious when displaying nonverbal behaviour that was consistent with Surinam norms (i.e., a cross-cultural judgment), compared to when displaying nonverbal behaviour consistent to Dutch norms (i.e., a within-culture judgment). According to the indirect aspect of the IDT, an interviewer's suspiciousness can affect interpersonal processes because the interviewee may attempt to restore his or her reliability, for example by increasing their mimicking behaviour (Dunbar et al., 2011).

In a more direct manner, interpersonal processes may be affected by culture because people's natural tendency to mimic may be dependent on the cultural background of both interactants. On the one hand, cultures differ in the their communication preferences and in the way they process information, with low-context communication on one side of the continuum and high-context communication on the other (Hall, 1976). Although all cultures have both low- and high-context features, cultures can be seen as low- or high-context depending on the importance of context during communication (Abriam-Yago, Yoder, & Kataoka-Yahiro, 1999). Direct communication focused on explicit messages and facts is the basis of low-context communication (e.g., if you do not cooperate with us, then we

will have difficulty solving the case; Kakabadse, Kouzmin, Kakabadse, & Savery, 2001), whilst high-context cultures communicate more indirectly with an emphasis on implicit messages and importance of relational context (e.g, we have had some recent setbacks increasing the difficulty of solving this case; Adair, 2003; Beune, Giebels, Adair, Fennis, & van der Zee, 2011). Low-context communication can predominantly be found in Western, mostly individualistic countries, such as the United Kingdom and the United States, while high-context communication is usually found in non-Western, more collectivistic countries, such as Russia and China. The former mentioned communication preferences may affect mimicry because arguably, the emphasis of low context communication on fact-based and consistent statements (Adair & Brett, 2004; Beune, Giebels, & Sanders, 2009; Grice, 1975) can make low-context communication more cognitively demanding than high-context communication. On the contrary, high-context communication relies more on nonverbal strategies and context than low-content communication (Würtz, 2005), and Chartrand and Bargh (1999) demonstrated that people who are more perceptually attuned to others mimic more.

On the other hand, people rely on cultural norms to provide guidelines on how to behave and interpret behaviour during interaction (Gudykunst, 1997). Although relying on cultural norms can be beneficial when interacting with someone from a similar culture, it may actually hinder correct interpretation of behavioural patterns in cross-cultural interactions (Taylor, Tomblin, Conchie, & Van Der Zee, 2013). Evidence that people have difficulty interpreting behaviour cross-culturally is provided by research on deception detection, which has shown that people are worse at detecting deception when interacting cross-culturally compared to same-culture interactions (Bond & Atoum, 2000; Bond, Omar, Mahmoud, & Bonser, 1990). A

possible explanation for this reduction in detection rates is provided by the expectancy violation model (Bond, Omar, Pitre, Lashley & Skaggs, 1992). Bond et al. (1992) revealed that when people display behaviour that was not expected by their interaction partner, they are being perceived as more dishonest regardless of veracity compared to people who did not display this unexpected type of behaviour. Differences in cultural background may facilitate the unexpectedness of behaviour, with culture-specific behaviours displayed by someone from a different cultural background may arguably be more unexpected, and consequently be perceived as more dishonest. In other words, when being unfamiliar with the interaction partner's cultural norms, their behavioural patterns may be more easily perceived as unexpected and consequently activate a lie bias. This suspicion in the interviewer can indirectly affect the interpersonal processes. More directly, people may have more difficulty recognizing and interpreting the behaviours of their interaction partner when interacting cross-culturally (Bond et al., 1990; Vrij et al., 2010), arguably causing a decrease in mimicry.

1.4.4 Interviewing style.

A final contextual variable that is likely to have a significant impact on mimicry is interview style. The current literature widely acknowledges two forms of interview styles. Accusatory interviews are aimed at increasing compliance and the likelihood of a confession by inducing anxiety, fear and guilt in suspects. This can be achieved through the use of accusation, manipulation and confrontation (Inbau, Reid, Buckley & Jayne, 2001; Meissner, Redlich, Bhatt, & Brandon, 2012). Information-gathering interviews are aimed at getting a full and truthful account, rather than a confession. Open-ended questions are used to encourage suspects to provide a detailed account of events through rapport-building and active listening (Hartwig,

Granhag, Strömwall, & Vrij, 2005; Meissner et al., 2012). How interviewing style affects nonverbal behaviour is only scarcely studied (Vrij, 2006; Vrij, Mann, & Fisher, 2006a), but results indicate that liars show more nonverbal cues to deception (e.g., decrease in hand and finger movement) when interviewed in information-gathering style compared to accusatory style interviews.

Thus, mimicry may be affected by interviewing style through the cognitive load route, or via a more socially oriented way. Although there is a general belief that information-gathering interviews are easier to undergo than accusatory interviews, when experimentally tested the opposite result arose (Vrij, Mann, & Fisher, 2006b). Accusatory interviews were perceived to be less cognitively demanding than information gathering interviews due to the elicitation of short and simple answers like "I didn't do it", rather than the detailed accounts provided after open-ended questions (Vrij et al., 2006b; Vrij, Mann, Kristen, & Fisher 2007). According to the positive relationship between cognitive load and mimicry, more mimicry would occur during information-gathering interviews compared to accusatory interviews. From a more social perspective, being interviewed in accusatory style is likely to create negative feelings like increased discomfort and the perception of dishonesty, whilst interviewees felt more positive about information-gathering interviews (Vrij et al., 2006b). How interviewees experience an interview may impact interactional mimicry, seen as the relationship between liking and mimicry is bi-directional (Lakin et al., 2003). Positive feelings towards the interview or interactant will increase mimicry and an increase in mimicry will positively affect feelings and opinions.

1.5 Current Thesis

Throughout this thesis, mimicry was measured objectively with the use of motion tracking equipment. Which devices were used to capture behaviour and

subsequently how a mimicry variable was extracted from the body motion data is described in Chapter 2. The nonverbal mimicry variable was then used to measure how mimicry is affected by lying. Specifically, the effect of cognitive load on mimicry is tested in Chapter 3, by asking participants to tell a truth and lies of increased difficulty. Subsequently, an alternative explanation of why mimicry may increase when lying was tested in Chapter 4. The interviewee's attention for the verbal or nonverbal behaviour of the interviewer was manipulated through the use of attention instructions to study if attention mediates the occurrence of mimicry.

In Chapters 5, 6, and 7 other, forensically relevant factors that may impact lie related mimicry in an interactive interview setting, were studied. In Chapter 5, the effect of second language use on mimicry is investigated, by having participants tell truths or lies in their first or second language. Language use may impact mimicry both indirectly, through suspicions in the interviewer, and directly, through consequences of speaking in a second language, such as behavioural changes and increased cognitive load. An increase in encounters between the police and individuals from different countries, does not only increase the amount of languages encountered, but also the amount of cultural backgrounds. How mimicry is affected by low- and high-context cultures, both when interacting with someone from the same, and from a different culture, is investigated in Chapter 6. British and South Asian interviewees responded truthfully or deceptively to questions about two pre-interview when they were interviewed by a British or South Asian interviewer. Last, when examining interpersonal processes, the behaviour of the interviewer is likely to affect the responses of the interviewee. To this extent, the effect of interview style on mimicry was examined. British interviewers asked British and South Asian interviewees questions about two pre-interview tasks in accusatory or information-gathering style.

Interviewees told the truth about one pre-interview task and lied about the other. How the results of all these experiments link together is discussed in Chapter 8.

Chapter Two: **The Automatic Measurement and Analysis of Nonverbal Mimicry**

2.1 Abstract

Nonverbal mimicry, the dependent variable investigated throughout this thesis, is measured automatically, rather than manually coded from videos. Technologies that measure human nonverbal behaviour have existed for some time and their use in the analysis of social behaviour has become more popular following the development of sensor technologies that record full-body movement. However, a standardized methodology to efficiently represent and analyse full-body motion is absent. In this Chapter, the advantages and challenges of investigating nonverbal mimicry from motion capture data are discussed. An overview of available motion capture systems is provided, and the two motion capture systems used throughout this thesis are described. The Chapter then goes on to describe the methodological protocol used in all the experimental Chapters of this thesis, including the recording, screening and normalization steps necessary to address the hypotheses. The Chapter concludes with a discussion of the method of analysis - Dynamic Time Warping-, including how this enabled an analysis of mimicry and how it extends existing approaches.

2.2 Introduction

Nonverbal behaviour is a key ingredient in personal expression (McNeill, 1985) and the regulation of interpersonal exchanges (Ekman, 1965). Its analysis has contributed significantly to our understanding of how human interaction works. It is perhaps not surprising, then, that researchers continue to develop methods for the effective measurement and analysis of such behaviour. The most common approach relies on observational coding of behaviour, using classification schemes that are developed to serve a particular research question (Lausberg & Sloetjes, 2009). These schemes are often evaluative in nature in the sense that researchers code for the occurrence of particular forms of communication, such as limb movement (Ekman, 1988; Stel et al., 2009) or facial expressions (Ekman, 1988; Porter & Ten Brinke, 2008). Although uncommon within the deception literature, other schemes are 'physicalistic' coding procedures that utilize a more precise mapping of behaviour by quantifying the movement of different limbs (Bente, 1989; Dael, Mortillaro, & Scherer, 2012; Frey & Von Cranach, 1973). For example, in physicalistic coding movement is not just coded binary (e.g., movement in the right arm, yes/no), but also the degree and the speed of the movement is taken into account (e.g., the right arm moved 8 centimeters to the left). This additional information is particularly useful when interpreting behavior. While the evaluative schemes are open to issues of reliability because of the qualitative component of the coding (Scherer & Ekman, 1982), the latter physicalistic schemes have been shown to yield reliable annotations that are sufficiently detailed to animate computer characters (Bente, Petersen, Krämer, & De Ruiter, 2001). However, for both approaches, the derivation of the data through coding is time consuming, meaning that there is often an inherent trade-off between the number of coded actions and the amount of coded material.

In an effort to circumvent this difficulty, there has been a growing trend toward using technologies to evaluate behaviour (Altorfer et al., 2000; Bente, Senokozilieva, Pennig, Al-Issa, & Fischer, 2008). Two distinctive uses of technological advances have been made to measure human behaviour. First, researchers have developed methods to automatically measure body motion from videos (Poppe, 2007). Related to this thesis is the work by Paxton and Dale (2013), who created a method to directly measure synchrony from video recordings. This is especially beneficial when working with already collected data, of which only video recordings are available. The major benefit of this method over manual coding is that it allows for a quantitative analysis, but the drawback is that the data and consequently the analysis, is strongly influenced by nuisance factors such as camera viewpoint, illumination and type of clothing.

Secondly, motion capture devices are increasingly used as an alternative to videos for the automatic measurement of human movement. Motion capture is the recording of movement (i.e., capturing), and can be applied to the movement of both objects and humans. A list of motion capture devices can be found in Table 2.1. Motion capture data have the benefit that they do not suffer from the noise drawbacks associated with automatically analysed video recordings. To date, motion capture approaches have focused on examining discrete nonverbal behaviour, such as head movement or gestures (e.g., Feese, Arnrich, Tröster, Meyer, & Jonas, 2012). Yet, to explore how body motion contributes to the processes of human interaction as observed in more naturalistic settings, there is a need to develop a methodology that allows for the capture over an extended period of time. This Chapter introduces a standardized approach to using motion capture methodologies for examining full-body motion. It describes how to process raw data independent of the type of motion

capture device and deal with issues such as distortions, alignment and normalization. It then focuses on using the automatic analysis of human behaviour to measure nonverbal mimicry, introducing a relatively novel approach to quantifying mimicry known as Dynamic Time Warping (DTW).

2.3 Automatic Measurement of Human Body Motion: Devices and Representation

The adaptation of modern computing technology and the development of dedicated technologies has made it easier for researchers to record and analyse human body motion (e.g., Dakin, Luu, Van den Doel, Inglis, & Blouin, 2010; Krishnan, Juillard, Colbry, & Panchanathan, 2009). Table 2.1 identifies some of the devices available for recording motion as a function of two distinctions in how they capture and treat movement data: i) whether they rely on markers or sensors to record movement; and, ii) whether they offer full-body or single movement capture.

Marker-based technologies use a set of cameras to detect markers worn on the body. These markers are either passive, such as retro-reflective balls, or active, such as infra-red transmitters. The former ensure good visibility but can cause confusion across markers, while the latter use distinct frequencies to avoid confusion. For both approaches, in order to obtain a 3D measurement of each marker, it must be visible to at least two cameras. This means that a large number of cameras are needed in order to avoid occlusion, particularly when studying social behaviour.

An increasingly popular alternative to compensate for this problem of marker confusion is to analyse full-body movement unobtrusively using single or multiple cameras, possibly aided by projected structured light (as in Microsoft Kinect, Shotton et al., 2013). From these devices, a digital volumetric estimation of the scene and the

people therein is made, in which one or more parametric body models are fitted (Poppe, 2007). The accuracy and robustness are currently lower compared to marker-based devices and suffer from similar occlusion problems as marker-based approaches. However, their unobtrusive nature may make them preferable to some research designs.

Table 2.1. Overview of body motion measuring devices.

Device Characteristics			Example
Full-Body	Type	Example Devices	Studies
Yes	Marker	Vicon MX, MotionAnalysis Raptor, Advanced Realtime Tracking ARTTRACK, Optitrack Arena, PhaseSpace Impuls X2, Phoenix Technologies Inc. Visualeyez, Qualisys Oqus	Slawinski et al., 2013
Yes	Inertial	Animazoo IGS, Ascension MotionStar, Xsens MVN, YEI Technology 3-Space	Kleinsmith et al., 2011
Yes	Vision	Microsoft Kinect, Ipi Soft, Organic Motion Openstage	Mead et al., 2013
No	Inertial	Ascension TrakSTAR, Polhemus Liberty Latus, Sparkfun Electronics WiTilt	Feese et al., 2012

Finally, inertial devices overcome the accuracy and occlusion drawbacks by measuring movements on the body, typically through sensors worn in a suit or straps. The sensors employ changes in the magnetic field in a gyroscope-like manner to make estimates of their positions. The accuracy of this approach is typically high, though the estimated positions can suffer from drift without additional position

measurements, notably in the presence of metal in the recording environment and objects therein. Moreover, wearing a tight-fitting suit may lead subjects to be more conscious of their behaviour, which threatens the ecological validity of any recorded social interaction. However, in experimental scenarios, the benefits of robust and accurate recordings provided by the inertial sensors are often a more attractive solution.

The current thesis utilises two varieties of the inertial systems to measure nonverbal behaviour: WiTilt v3 and the Xsens MVN suit. A WiTilt is a matchbox-sized single sensor device that contains a 3-axis accelerometer, a gyroscope, and a Bluetooth transmitter that enables wireless communication of the movement data. The devices continuously read out measurements from the inertial sensors at a frame rate of 120 times per second and communicate those to the recording computer. The device can be easily secured to a limb using an elasticated band without hindering natural movement. The Xsens MVN inertial system is a more sophisticated technology that captures full body movement from 17 inertial sensors strapped to the body. These inertial sensors record acceleration 120 times per second in three dimensions, and the resulting measurements can be transformed to 3D positions of 23 joints (by taking the double integral of the acceleration values and) using the known relative sensor locations that have been obtained in a prior calibration phase. Figure 2.1 shows an example of a WiTilt v3 devices and a Xsens MVN full-body suit as used in this experiment. In this thesis, Chapters 3 and 4 use the Wi-Tilt devices to measure mimicry, while Chapters 5, 6 and 7 use the Xsens MVN system. The use of both inertial systems was due to the initial accessibility of single sensor devices, which allowed investigating mimicry in separate limbs. Subsequently, the purchase of two Xsens MVN systems allowed for a more detailed measurement of full-body mimicry.

Beneficially, the use of multiple systems demonstrates that the obtained results are not system specific.

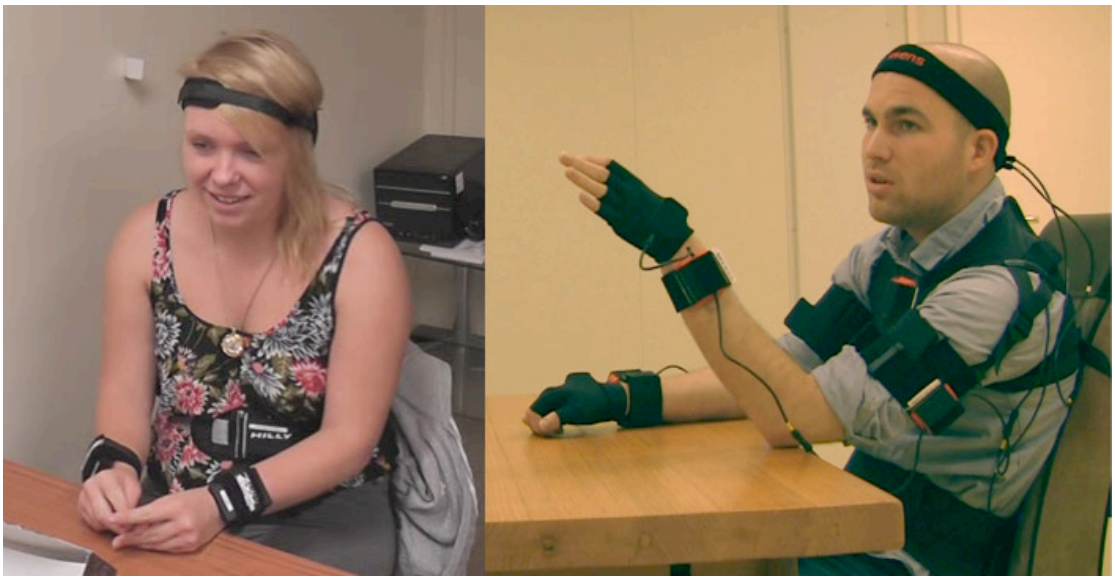

Figure 2.1. WiTilt v3 sensors and Xsens MVN suit

This Chapter examines behaviour from both of these devices using the recently developed AMAB method (Poppe, Van Der Zee, Heylen, & Taylor, in press). Independent of the type of device used to record movement, the AMAB system uses a standardised representation of the movements in data. The basis of AMAB is the notion that the human body is most efficiently described in terms of a series of body parts and joints, the former being shapes with a certain length and the latter being single points in space. Together, body parts and joints form a tree-like representation of the human body, and movement may be described in terms of the displacement and rotation of the joints with respect to this tree. Figure 2.2 shows a schematic illustration of this 'kinematic tree'. The joint at the top of the tree, usually the pelvis, forms a root to which all other joints are relative.

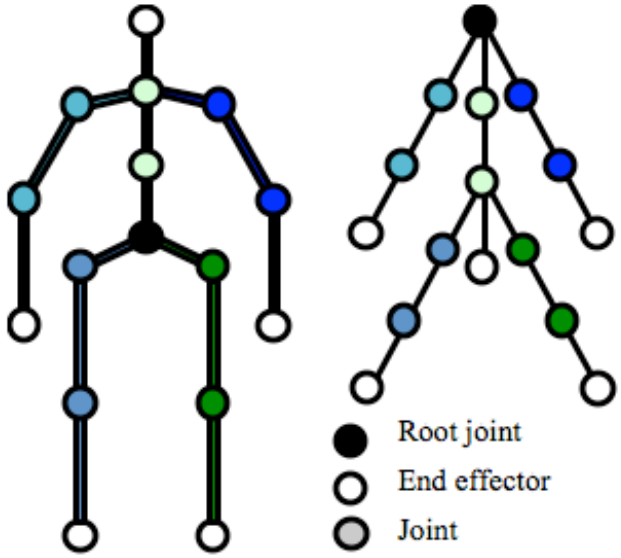

Figure 2.2. Human body representation (left) and kinematic tree (right).

When two joints are connected to a body part, the one higher in the tree is considered the parent and the other the child, such that joints higher in the hierarchy affect those below. For example, movement in the right shoulder affects the right elbow and wrist joints. End-effectors are joints without children (i.e., feet, hands and head). Although normally sensors and markers are not attached at the location of the joints, this was the case for the WiTilt devices used in Chapters 3 and 4. While one could, in principle, use the sensor locations to analyse human movement, there is no guarantee that these locations are the same between subjects. As a consequence, motion capture equipment often employs a calibration phase to determine the joint positions relative to the sensors' placement.

A full-body pose can be described by the rotations or positions of the joints, of which the latter is computationally more straightforward. Although there are a few available approaches to expressing the joint position, the most convenient for full-body capture is to use global representations, largely because they make the

comparison of joint positions in time and space across subjects straightforward. In this approach, joint positions are expressed by three position values corresponding to the distance from the origin (i.e., the point (0, 0, 0)) along each of three pre-defined orthogonal axes (i.e., x, y, z). Most devices in Table 2.1 can output global joint positions, with the WiTilt devices being the exception to the rule. The software supplied with these devices output textual representations either in XML or column format.

Once the movement has been recorded, it can be visualized in the same way as a recorded video. It is possible to have raters quantify the behaviour in such visualizations by using both evaluative and physicalistic coding approaches. However, automatic measurement of body motion results in numerical representations of the body's position over time that enables a range of statistical analyses, arguably more sensitive and less prone to error than human coding. The remainder of this Chapter considers the possibilities afforded by such an approach. To facilitate the description of the AMAB processing steps, I denote the k^{th} measurement of body pose as a vector: $x^k = (x_1^k, ..., x_m^k)$, with $k \in \{1, ..., m\}$ for a recording with m measurements. Each component of the vector corresponds to a joint position measurement along an axis. Without loss of generality, it is assumed that the measurements are available as a matrix with m rows and n columns. Each row corresponds to a full-body measurement x^k. The n position measurements are in fixed order of joints and axes, with each subsequent triplet of columns corresponding to the (x, y, z) values of one joint.

2.4 Data Screening

Data recorded by devices such as those listed in Table 2.1 can be distorted in many ways. It is therefore necessary, as it is with all inferential statistics in

psychology, to screen the data prior to analysis. This process includes removal of data distortions and normalization.

2.4.1 Data distortions.

Data distortions are due to measurement noise and longer-term inconsistencies in the data due to equipment or transmission failure. The most common noise are incidental values, which occur as a result of tracking failure (e.g., due to missing marker detections or magnetic resonance). The nature of equipment failure depends on the type of body motion device. When the time of failure is short, the missing measurements can be interpolated from the measurements before and after the failure. Linear interpolation is typically a reasonable approximation provided that the amount of (de)acceleration is low (Poppe, 2007). Additionally, data points that exceed the possible reading values for a sensor need to be removed, since these represented electronic recording errors.

2.4.2 Normalization.

There are a number of common analytical problems in interaction research, and these largely remain when analysing recorded body motion. To compare body movements within or between recording sessions, or within or between subjects, differences in the recording space and time must be taken into account. The most straightforward approach to removing such variations, adopted in AMAB, is to apply one or more forms of normalization.

2.4.2.1 Normalization in time.

When multiple recordings are made simultaneously, synchronization is either handled by the recording software or established during data screening. The latter case occurs when recordings have been made on different computers or with different software (e.g., motion capture and video recording software). Typically, motion

capture devices record at a relatively high fixed frame rate, e.g., 120 Hz. Such a high number of measurements per second is impractical and often unnecessary, making down-sampling an attractive alternative. Down-sampling has been shown to smooth the movement data and make the analysis more tractable, with negligible loss of sensitivity to human-perceivable movement of individual limbs.

In this case, there are two possible types of normalization required: frame rate alignment and synchronization. When frame rates differ between data streams, the measurements in each data stream must be resampled equidistantly in time so that the data align to a fixed rate. The data streams may then be synchronized in time by determining the latest start point and earliest end point across the recordings, and the recordings trimmed to these points. Synchronization ensures that the recordings cover the same time interval. To determine the maximum time interval that is covered by all recordings, the latest start point and earliest end point are determined. For two data streams A and B, with mA and mB measurements and time stamps tA and tB, respectively, the new start (tS) and end (tE) point are determined as:

$$t^S = \max(t_A^1, t_B^1),\ t^E = \min(t_A^{m_A}, t_B^{m_B}). \quad (1)$$

For each data stream, the corresponding start and end measurement index are determined, i.e., $k_A^S = \arg\min_i \{t_A^i \geq t^S\}$ is the start index of data stream A. This approach can be applied to any number of data streams, or to align a stream to a stimulus prompt. See Figure 2.3 for a schematic representation of the alignment process. The result of normalization in time is a synchronized analysis with maximum usage of the available data.

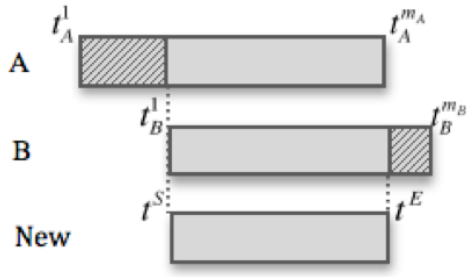

Figure 2.3. Schematic representation of the temporal alignment of two data streams.

2.4.2.2 Normalization in space.

The global position of a subject in the recording space affects all joint positions. This is undesirable when comparing the body pose of a single subject at different time instances, or when comparing the body postures of multiple subjects. Without normalization in space, the difference in global position will influence the pairwise comparisons of the positions of each joint. Poses are normalized for position by mean centering all position measurements relative to the root of the body. Typically, the pelvis is used as the root joint *P*, and its location in the recording space is translated to (0, 0, 0). Mean centering of the data may be applied to all other joints through the subtraction of *P* from the position of each joint *j* individually:

$$(x'_{jx}, x'_{jy}, x'_{jz}) = (x_{jx} - x_{Px}, x_{jy} - x_{Py}, x_{jz} - x_{Pz}) \quad (2)$$

Figure 2.4 shows an example of this kind of position normalization for the case of two subjects seated at opposite sides of a table. When comparing the poses of the two subjects, the absolute distance between them is not important. Therefore, it makes sense to apply normalization in space according to eq. 2. The result is shown in Figure 2.4(I).

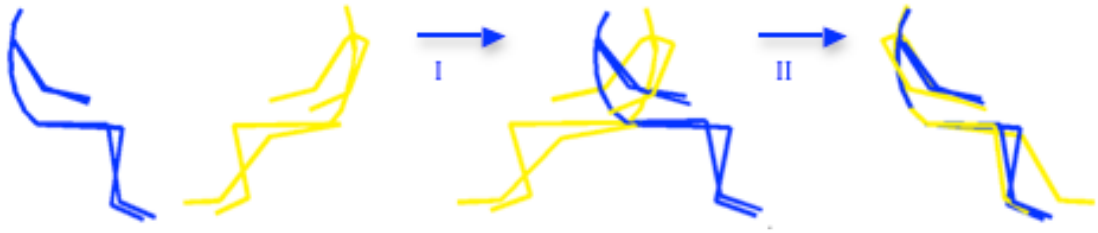

Figure 2.4. Schematic example of normalization of position (I) and orientation (II).

However, the global body orientation (i.e., facing direction) of subjects typically affects comparisons between poses, which is undesirable. When interested in the similarity of the subjects' poses, an easier comparison is made by rotating the pose of one of the subjects 180 degrees around a vertical axis, as shown in Figure 2.4(II). To apply this normalization in orientation, it is assumed that poses are normalized for position and that the y-axis is pointing upward. All joints are rotated around the y-axis in such a manner that the subject faces the positive x-axis. To this end, the hips are placed parallel to the z-axis. The angle of rotation θ is determined as:

$$\theta = \arctan\left(\frac{x_{LHx} - x_{RHx}}{x_{LHz} - x_{RHz}}\right) \tag{3}$$

with *LH* and *RH* the indices of the left and right hip, respectively. Next, all joints are rotated around the y-axis with angle θ. For joint *I* with position (x_{Ix}, x_{Iy}, x_{Iz}), the y-position (i.e., the height) remains unchanged while the rotated x- and z-positions are determined by:

$$\left[x'_{Ix}, x'_{Iz}\right] = \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} \begin{bmatrix} x_{Ix} \\ x_{Iz} \end{bmatrix} \tag{4}$$

2.4.3 WiTilt v3.0 data screening.

The procedure for screening WiTilt output within this thesis followed the main process of data screening presented above, but it differed at some points because

WiTilt devices do not output global joint positions. Rather than focusing on position data, the amount of acceleration (R) was used to determine movement. WiTilt output was screened in four stages. First, the occasional data point whose value exceeded the possible reading values for the sensor was removed, since these represented electronic recording errors (approximately 0.5%). This step was performed to remove data distortions. Second, because it was not possible to ensure that each WiTilt device began recording at the exact same moment, the data streams were aligned with the use of Equation 1. Specifically, the data of each device was aligned so that the readings were aligned with the first reading from the sensor whose recording began last. Third, to ensure that the streams remained aligned across the interaction, which may not have been the case once data had been removed, the data were down-sampled to 5 frames per second (i.e., measurements covering 200ms were averaged into a single data point). Five frames per second were chosen as a trade-off between accuracy and computing time. This step, combined with the previous step, performed the task of normalizing the data in time. Forth, because the absolute values of device outputs are influenced by their body placement, standard scores of the acceleration data on each axis for each limb were produced.

2.4.4 Xsens MVN data screening.

It was possible to screen the data produced by the Xsens MVN system in just two stages. This is because no data distortions occurred when using Xsens MVN equipment and because the simultaneous recording of the data of both participants with the same software program circumvented issues with frame rate alignment and synchronization. Consequently, the only normalization in time that was implemented was down-sampling the data for each joint by averaging positions five times per second (i.e., measurements covering 200ms were averaged into a single data point).

Second, the data was normalized in space with the use of Equations 2, 3 and 4. This allowed aligning the two participants by mean-centering all joint locations to the pelvis. Since interactants were facing each other in experiments, this alignment also involved rotating the joint locations for the interviewer 180 degrees around the vertical axis.

2.5 Measuring Nonverbal Mimicry

This section describes how the results of the initial AMAB analysis were used to create a nonverbal mimicry dependent variable. This process involved two stages: An initial calculation of pose differences at each time frame of interaction and subsequently, an analysis of these differences across time using a statistic known as Dynamic Time Warping (DTW) to calculate a measure of nonverbal mimicry.

2.5.1 Pose difference.

When comparing two poses *A* and *B*, their difference can be expressed as the sum of the distances between each of the joints *j* in the set *J*:

$$\delta_{A,B} = \sum_{j \in J} \sqrt{(x_{j_A x} - x_{j_B x})^2 + (x_{j_A y} - x_{j_B y})^2 + (x_{j_A z} - x_{j_B z})^2} \quad (5)$$

The distance for each joint individually is calculated using Pythagoras theorem. Pose differences can only be calculated when the sets of joints *J* are equal and poses have been equally normalized.

2.5.2 Nonverbal mimicry.

Once pose differences have been identified across time, it is possible to determine the degree of mimicry between actors by examining the extent to which the movement of the two individuals overlaps and diverges from one another. To do this, the pose differences calculated from Equation 5 were summed to create a single ‘pose difference’ score for the 23 joints. Thus, if the poses of two actors are identical, the

summed score will be zero. If the poses differ, the degree of the difference will be reflected by the value of the difference score; the higher value indicating a greater difference. When analysing across time, this will result in a sequence of values indicating the differences in pose between two interactants for each time frame in the measured period of time. These values can be added up to create a total score that resembles how different the poses of two individuals were during a certain period of time. However, this only allows for comparison between poses performed at the same moment in time, while mimicry can occur not only at the same moment, but also within a short time window (usually up to 10 seconds; Chartrand & Lakin, 2013; Lakin et al., 2003; Stel et al., 2009). Additionally, people do not mimic in a constant manner; rather it varies in time delay.

In order to capture this dynamic of human interaction, a technique known as Dynamic Time Warping (DTW) was used. DTW may be thought of as a form of correlation that computes the optimal alignment in time (Rabiner & Juang, 1993) between two data streams corresponding to persons *A* and *B*. The DTW analysis operates on a matrix *M* with elements $M_{i,j}$. Here *i* corresponds to the i^{th} pose measurement of person *A*, and *j* corresponds to the j^{th} pose measurement of person *B*. $M_{i,j}$ is then the difference between the two poses, calculated using Equation 5 in the case of Xsens MVN measurements. The total amount of poses and the time distance between two poses are variable and depend on choices made by the researcher rather than being caused by restrictions posed by the algorithm. This matrix representation allows for not just calculating how similar poses were during the entire interview at the same moment in time (when $i = j$), but also for calculating pose similarity for different moments in time. The DTW technique then seeks to identify the optimal path through this matrix (i.e., data streams of both individuals are stretched and

compressed until they are optimally similar in terms of Equation 5; the DTW package can be accessed through http://dtw.r-forge.r-project.org/). This path determines temporal alignment of two data streams.

How the two data streams can be aligned, is restricted by the use of a step pattern that prescribes which alignment steps can be taken. In practice, such alignment steps are determined at each alignment frame and the amount of compression and expansion is limited by the set of possible discrete steps. Typically, the choice for a step pattern depends on the type of application, data and frame rate. For the alignment of the body motion data streams, the normalized and unbiased Rabiner and Juang step pattern 6C was chosen, which allows for moderate changes in the alignment (Rabiner & Juang, 1993; see Figure 2.5). Specifically, the next alignment frame is either the next frame in both data streams, or two frames advanced in one data stream and three in the other. Compression and expansion of the time scale is achieved with the latter. For example, after alignment, 10 seconds of data from person *A* can be matched to a minimum of 6.7 seconds and a maximum of 15 seconds of data from person *B*. A further restriction is that both data streams start and end at the same time, which limits the maximum difference in temporal alignment. With step pattern 6C, the final DTW score is then obtained as the average value of the pair-wise (Euclidian) distance between the two data streams at each alignment frame.

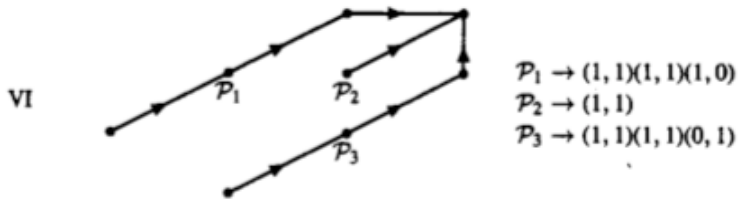

Figure 2.5. Rabiner Juang step pattern 6.

2.5.2.1 DTW as used in this thesis.

In its original formulation, higher DTW scores are associated with less similarity between the two data streams. In the current context, higher DTW scores indicate less nonverbal mimicry. For the ease of interpretation, all DTW scores in this thesis are multiplied by -1 to create negative DTW scores in order to create a positive relation between DTW scores and nonverbal mimicry. This allows for the more instinctive interpretation of higher DTW scores being associated with more mimicry.

In Chapters 3 and 4, four single sensor WiTilt devices were used per participant to calculate the occurrence of nonverbal mimicry through movement in people's head, trunk and both wrists. Due to the different output of single sensor WiTilt devices, some adjustments were made to allow for DTW analysis. Although the raw output of the WiTilt devices contains several measures of movement (i.e., acceleration, tilt), the analyses were based on the gyroscope readings (recorded as R-values within WiTilt's output). This set of readings measures the amount of velocity (i.e., motion) enacted on the WiTilt device at any one time, and so it provided an appropriate single measure of limb movement. The screened data for interviewer-interviewee pairs were then used to calculate a pose difference score for each body part. Because the absolute values of device outputs were influenced by their body placement, raw data was transformed into *z*-scores. *Z*-scores were multiplied by a 1,000 to convert fractions into integers. In addition, the four DTW scores per limb were averaged to provide an upper-body nonverbal mimicry measure per pair of interactants.

In Chapters 5, 6 and 7, two Xsens MVN suits were used to calculate the occurrence of nonverbal mimicry. These suits allowed for a more precise capturing of human movement, measuring 23 joints rather than the four joints that could be

measured with the WiTilt v3.0 devices. Depending on the interview setting, an upper- or full-body measure of nonverbal mimicry was calculated. Only upper-body behaviour was measured when interactants were sitting at a table during the interview (Chapters 5 and 7), while a full-body measure was calculated when the interactants could see each other's entire body during the interview (Chapter 6). All joints were used to calculate the full-body measure, while leg and foot joints were not included in the calculation of the total difference score for the upper-body measure.

2.6 Discussion

The main benefit of using a full-body automatic method of capturing nonverbal mimicry is that the resulting analysis includes the smallest of expression—both in terms of direction and magnitude of movement—that is not restricted in the variety of movements that it can measure. Moreover, by capturing the direction and magnitude of behaviour, the automatic approach offers an important difference in specificity compared to manually coding of interactions. When coding videos of interactions, matching is a binominal decision depending on the interpretation of the coder. If person *B* moves his hand within 10 seconds of person *A* also moving his hand, it is likely that this will be counted as mimicry, regardless of the actual similarities of the right hand movement. When automatically analysing behaviour, mimicry is defined on a scale, not binomially. In practice, just moving the same limb is not enough to count as mimicry when automatically analysing behaviour. Instead, the more similar the direction and magnitude of the movements are, the more the movement counts as mimicry. Thus, an automatic analysis of mimicry means a different operationalization of the concept of mimicry, one that is not based on the intention of the actor but on the extent to which the actor achieves the same movement as their interlocutor.

Chapter Three: **Automatic Nonverbal Mimicry Increases with Lie Difficulty**

3.1 Abstract

Chapter 1 put forward two competing hypotheses about the effect of deception on interpersonal nonverbal mimicry. To provide a first test of these hypotheses, this Chapter examines the impact of telling easy, difficult and very difficult lies on the nonverbal mimicry between interviewer and interviewee. Interviewees told the truth about a conversation, concealed their cheating during solving a puzzle task (easy lie), and fabricated an account about a game of Clue in either forward (difficult lie) or reverse order (very difficult lie). Results showed that interviewer-interviewee mimicry increased with lie difficulty, both for total body movement and individual limbs. These results support the cognitive hypothesis, with nonverbal mimicry increasing with greater cognitive load. In addition, they highlight the importance of examining deception as an interactive processes, rather than focussing solely on the behaviour of the liar.

3.2 Introduction

Studies of nonverbal cues to deception tend to examine the differences in behaviour that occur across truths and lies. These analyses almost invariably focus on the behaviour of the interviewee without recognition of the interpersonal nature of the interaction or the impact of the interviewer's behaviour (Burgoon & Buller, 1994). However, interaction is a fundamentally social process, where the actions of one person are influenced by the actions of their interlocutor (Chartrand & Van Baaren, 2009; Garrod & Pickering, 2004). This raises an interesting and rather unexplored question about liars' nonverbal behaviour, namely, how does the act of deceiving impact the interpersonal dynamic between interviewer and interviewee?

One feature of nonverbal behaviour that is central to interpersonal interaction is mimicry. As outlined in Chapter 1, nonverbal mimicry is the tendency to imitate, either automatically or strategically, the behaviours of other people within a short time window (Chartrand & Lakin, 2013; Lakin et al., 2003; Stel et al., 2009). Arguably it is the automatic aspect of mimicry that is particularly relevant in a deception context, as behaviour control is one of the main obstacles in the search for universal nonverbal cues to deception (Vrij, 2008). If people are usually not aware of their mimicking behaviour, they will not attempt to control it, suggesting that if mimicry differences between truth tellers and liars exist, observing mimicry levels during interaction could be an effective way of detecting deception.

Precisely how deception impacts nonverbal mimicry remains an open question. On the one hand, to the extent that mimicry is an automated process, then it may be predicted that it remains uninfluenced by lying, or indeed used more within lying because the liar diverts cognitive resources to other aspects of their interpersonal behaviour. Mimicry standardly occurs in most social interactions, regardless of

people's preoccupation with other tasks (Chartrand & Lakin, 2013). This automatic seeing-is-doing tendency is described by Chartrand and Bargh (1999) via the two-step perception-behaviour link. Observation of specific behaviours may activate stereotypes, trait conducts and behavioural representations, influencing one's subsequent behaviour. In their study, participants who worked on a task with a foot rubbing or face touching confederate specifically mimicked the displayed behaviour by the stranger without awareness.

This automatic occurrence of mimicry (Chartrand & Bargh, 1999; Heyes, 2011) was not just confirmed, but also further extended in a study examining finger movements cued by finger movements or spatial cues (Van Leeuwen et al., 2009). Only when cognitively loaded with other tasks, participants moved their finger quicker in response to the finger movement than the spatial cue, providing evidence that mimicry increases under cognitive load. Similar results were found by Kühn & Brass (2008), who found that although finger movement speed decreased when increasing cognitive load by simultaneously speaking a word out loud, when imitating finger movement this decrease was smaller compared to when imitating a moving square symbol (i.e., a non-imitative response). Further support for the increase in importance of automatic processes when under higher cognitive load is provided by experimental research on attitudes (Hofmann et al., 2007). The former suggests an increase in nonverbal mimicry under the cognitive load of lying.

On the other hand, although lying in interview-settings usually increases cognitive load, some characteristics unique to lying might interfere with a liar's behaviour and subsequently influence mimicry. Research has argued that liars choose to 'freeze' and deliberately limit their movement as a way of avoiding the presentation of deceptive cues. This attempt to control unnecessary behaviour can

lead to an overcontrol (Vrij & Heaven, 1999) and may appear rigid, rehearsed and unnatural (Vrij, 2008). Behavioural control may reduce mimicry via two routes: First, a liar's tendency to control their movements to avoid leaking cues that may reveal deceit can cause suspicion in the receiver. This was assumption was tested and confirmed by Burgoon and Buller (1994), who found that liars indeed controlled their behaviour by becoming more formal, restrained and tense, leading the interviewer to judge the liar more negatively than truth tellers. These findings provide evidence that not just the presence of deceptive cues, but also the absence of normal, fluent communication as a result of behavioural control may increase suspicion and reveal deceit. Subsequently, the interviewer's suspicion was found to disrupt interaction patterns (Burgoon & Buller, 1994), which will cause mimicry to decrease. Second, both behavioural control and increased load have been found to decrease movement (Ekman & Friesen, 1972; Vrij, 2008), reducing the overall animation of the liar. This movement reduction is most likely to only happen to the liar and not to their interaction partner, creating a movement discrepancy between interlocutors. Arguably, the occurrence of freezing and a movement discrepancy may decrease mimicry levels.

3.2.1 The current study.

To examine the influence of cognitive load on interviewer-interviewee mimicry and test the alternative accounts presented above, the nonverbal behaviour of interviewers and interviewees were examined across four accounts of increasing difficulty. Specifically, cognitive load was manipulated by having interviewees tell a truth, a concealment lie, a fabrication, and a fabrication told in reverse order. According to previous research, these lies should increase in their difficult, since lying is usually more cognitively demanding than truth-telling (DePaulo et al., 2003; Vrij et

al., 2010; Kassin & Gudjonsson, 2004), fabrications are more cognitively demanding than concealments (Vrij & Heaven, 1999) and accounts given in reverse order are more difficult than those given in normal order (Vrij et al., 2008). It was therefore predicted that nonverbal mimicry would either increase or decrease across these accounts depending on whether the negative effect of interactional disruptions caused by the controlling behaviour and increased load of the liar on mimicry is larger than the increased importance of automatic processes when cognitively loaded.

3.3 Methods

3.3.1 Participants.

Ninety-eight male undergraduate and graduate students from Lancaster University (Age M = 20.9 yrs, Range 18 - 36) acted as the interviewee participant (hereon 'interviewee') or the interviewer participant (hereon 'interviewer'). Only male participants were recruited to avoid the impact that sex may have on mimicry. The interviewees (n = 49) participated for approximately 70 minutes in return for payment of £8. The interviewers (n = 49) participated for approximately 40 minutes in return for £5. Six pairs of participants were excluded from the analysis because of technical problems with the automatic nonverbal behaviour measurement, leaving 43 pairs.

3.3.2 Procedure.

The experiment comprised two stages: a pre-interview stage in which the interviewee completed three tasks, and an interview stage in which the interviewer questioned the interviewee about these tasks. The tasks of the pre-interview stage were designed to increase in their complexity of their details. The tasks involved a conversation with a confederate, concealing having cheated on a puzzle task and pretending to have played a game of Cluedo. These tasks were chosen because they

have components that resemble forensically relevant situations (e.g., recalling a conversation with a "partner in crime", concealing that you and "your partner in crime" cheated and a game of Cluedo -the European equivalent of the US boardgame Clue- involving a crime, different locations, people, and weapons, and the importance of order and time). Telling a truth was considered the easiest task because lying usually is more difficult than truth telling (DePaulo et al., 2003; Vrij et al., 2010; Kassin & Gudjonsson, 2004). The three lies of increasing difficulty comprised of a concealment (i.e., easy lie), fabrication (i.e., difficult lie) and fabrication in reverse order (i.e., very difficult lie).

3.3.2.1 Pre-Interview.

The first task involved having an informal conversation with a confederate who was posing as a participant. The experimenter instructed participants to discuss whatever they liked, and she reassured them that their conversation was not being recorded. She then left the room and returned after five minutes.

The second task involved the interviewee and confederate solving a wooden puzzle together. The experimenter indicated that they had five minutes to solve the puzzle, and that previous participants had no trouble doing so. This last instruction sought to induce pressure on the interviewee to complete the puzzle. The experimenter then left the room, but while doing so she 'accidentally' left the puzzle instructions, which included the solution, in a bag on a side table (the bag was used to carry the puzzle into the room). During the five minutes, the confederate began working on the puzzle with the interviewee. After approximately two minutes, she gave up and pretended to notice the instructions. She then encouraged the interviewee to cheat and, having previously been trained, proceeded to help him solve the puzzle and replace the instructions in the bag. After five minutes, the experimenter returned,

pretended to see the instructions, and asked the interviewee and confederate whether or not they had used them. The confederate gave the interviewee time to respond (and confess) first. If he did not admit to the cheating, the confederate explained that they had used the solution together to solve the task. In both cases, the experimenter would sigh, think for a few seconds, and say: "Sorry, that is my fault, I should not have left them there. I do not think it's really a problem. It is just that I only just started my PhD here and with the videos of the interview my supervisor is going to teach me how to code videos. Therefore, I would prefer if you would not mention that I left the solution in the room during the interview, because that will get videotaped and next time I will watch it, my supervisor will sit next to me. Would you mind not mentioning that you cheated when you get asked about this part in the interview?" All interviewees agreed to this request.

The third task began with the experimenter explaining that the participant and confederate posing as a participant would be separated. She then 'selected' the confederate and asked the interviewee to wait in the room while she and the confederate went to another room. After a couple of minutes, the experimenter returned and told the interviewee the following: "For this part of the task you are going to have to use your imagination by making up a story about playing a game of Cluedo with three other players. The other participant has just gone to meet these three other players but the game is a set up. The three players are confederates who will act in certain ways that move the game to a predetermined outcome. The interviewer has information about this game and his task is to try and work out whether the other participant or you were the fourth player in the game. So, your task is to convince the interviewer that you played Cluedo with the three confederates. If

you do this successfully, you will be entered into a prize draw to win an iPod. Also, please remember to conceal the fact that you cheated in the puzzle game."

The interviewee was given an information sheet containing all details that would be necessary to present as somebody who was in the room playing Cluedo. This included the names and photos of the three other players, an information sheet with game specific information, and a real Cluedo board so that they could familiarize themselves with the game. The interviewee was then left for 10 minutes to process this information and fabricate a story about the game. After this time, the experimenter returned and took the interviewee to another room for the interview stage. In all cases, the interviewee expressed being confident enough to talk about the game after this time. In debrief, none reported realizing that their partner during the first two tasks was a confederate, and the majority expressed surprise when this was revealed.

3.3.2.2 Interview.

Before entering the interview room, the experimenter reminded the interviewee that there would be questions on the informal conversation to which he should respond truthfully, questions on the wooden puzzle to which he should conceal that he had cheated, and questions on the Cluedo game to which he should fabricate an account convincing the interviewer that he was the fourth player. On entering the interview room, the experimenter introduced the interviewee to the interviewer and helped them both attach motion capture devices to their wrists, head and torso using soft Velcro bands (see Measuring Nonverbal Communication below and Chapter 2).

Once set up, the experimenter gave the interviewer a set of questions about the first pre-interview task. The experimenter then retreated to sit behind a screen to

monitor the data capture in a way that the participants could not see her and would not get distracted by the presence of a third person during the interview.

Once all questions about the first task were asked, the experimenter provided both the interviewee and the interviewer participants with a post-task questionnaire. This questionnaire, which they completed independently, required participants to indicate their agreement to a series of statement using a 'not at all' (1) to 'very much' (7) Likert scale. For the interviewee participant, five statements asked about the extent to which they agreed that: i) the task was difficult; ii) they had performed well; iii) they were anxious; iv) the interaction was well-paced; and, v) the interaction was awkward. For the interviewer participant, six statements asked about the extent to which they agreed that: i) the interviewee was telling the truth; ii) the interaction was well-paced; iii) the interaction was awkward; iv) the interviewee was trustworthy; v) the interviewee was honest; and, vi) the interviewee was suspicious.

Once both participants had completed their rating, the interviewer received a set of questions related to the next pre-interview task. Once these questions were asked, the experimenter provided another post-task questionnaire, and this cycle was repeated for the third task. When it came to questions about the Cluedo game, a further manipulation was introduced to increase the question difficulty. Specifically, half of the interviewers asked the Cluedo game questions in forward order, while the other half asked the questions in reverse order. Previous research suggests that asking participants to recall an event in reverse order is more difficult, particularly for liars (Vrij et al., 2008).

The order in which the topics were discussed at interview was counterbalanced to test for order effects. Specifically, half of the interviews began with the informal conversation, followed by the puzzle and Cluedo game, and half

began with the Cluedo game, followed by the puzzle and the informal conversation. There were no significant order effects.

After the interview, both participants were helped taking off the WiTilt v3.0 devices and were both verbally and in reading debriefed about the true purpose of the study. Before debriefing, participants were asked if they knew what the study was about. Although all participants knew from the use of the WiTilt devices that their behaviour was being examined, none mentioned mimicry by themselves. Moreover, on revealing the true purpose of the experiment, none reported deliberately having used mimicry.

3.3.3 Measuring nonverbal mimicry.

To measure the mimicry of interviewer and interviewee, WiTilt v3.0 (Sparkfun Electronics Inc., 2008; see Chapter 2) motion capture devices were used. Four devices per person were secured to a limb using an elasticated band, without hindering natural movement: one was attached to the side of the head, one to the centre of the chest, and one to each wrist of both the interviewer and interviewee. Because mimicry occurs with a short time delay, and because that delay itself can vary in length across the interaction, we measured movement similarity using Dynamic Time Warping (DTW; see Chapter two for a detailed description). By calculating negative DTW scores, a positive relationship between mimicry and DTW scores was created to increase the ease of interpreting the mimicry results. In addition to separate limb data, we averaged the four DTW scores per limb to provide an overall, upper-body measure per pair.

3.4 Results

3.4.1 Manipulation checks.

The post-hoc questionnaire responses provided the opportunity to check that the manipulation of lie type impacted interviewees' experiences. Three regressions with curve fitting with Task type as the independent variable and self-reported Difficulty, Anxiety and Confidence as the dependent variables revealed main effects for all three self-reported emotions. Interviewees reported finding three out of four tasks increasingly more difficult, from truth (M = 2.79, SD = 1.57), easy lie (M = 2.37, SD = 1.50), difficult lie in forward order (M = 3.00, SD = 1.31), and very difficult lie in reverse order (M = 4.05, SD = 2.01), r = .24, $F(1, 127) = 7.99$, p = .005. They also reported feeling increasingly more anxious across the tasks, from truth (M = 2.95, SD = 1.62), easy lie (M = 2.51, SD 1.35), difficult lie in forward order (M = 3.05, SD = 1.33) and very difficult lie in reverse order (M = 3.86, SD = 1.82), r = .19, $F(1, 127)$ = 4.50, p = .036. Finally, interviewees indicated that they felt increasingly less confident across three out of four tasks, from truth (M = 4.79, SD = 1.73), easy lie (M = 5.67, SD = 1.44), difficult lie in forward order (M = 4.68, SD = 1.64), and very difficult lie in reverse order (M = 3.76, SD = 2.14), r = .20, $F(1, 127) = 5.00$, p = .027. A Pearson correlation revealed that mimicry was positively correlated with an interviewees' self-reported difficulty, r = .26, n = 128, p = .003.

As part of the post-task questionnaire, for each topic, interviewers were asked to judge if the interviewee was being truthful or not. A comparison across judgment accuracy serves as a manipulation check for cognitive load, since previous research has shown that judges find it easier to identify lies when the liar is under high as opposed to low cognitive load when lying (Vrij et al., 2008). A chi square analysis in which only lies were taken into account revealed a significant association between lie

difficulty (e.g., easy lie, difficult lie and very difficult lie) and detection rates, X^2 (2) = 11.21, $p < .004$, $\Phi = -.36$. Interviewers were on average better at correctly identifying the very difficult lie in reverse order (57% correct) compared to the difficult lie in forward order (32% correct) and easy lie (16% correct). Phi (Φ) is a commonly used effect size for measures of association and was used throughout this thesis as the effect size measure of chi square calculations. Phi is computed by taking the square root of X^2 divided by the sample size. A second chi square analysis comparing truths with lies revealed that interviewers were also more accurate at correctly identifying the informal conversation as truthful (63% correct) than they were at identifying lies overall (30% correct), X^2 (1) = 12.55, $p < .001$, $\Phi = -.31$. The finding that lay people are better at detecting truths than lies is in line with the literature, with truths being correctly identified 61-63% of the time, whilst lies being correctly detected 47-48% of the time (Bond & DePaulo, 2006; Vrij, 2008). For lay people, this finding can partly be explained by the tendency to judge accounts as truthful, rather than deceptive (Zuckerman et al., 1981). This is termed a truth bias.

3.4.2 Mimicry.

To test the prediction that interviewer-interviewee mimicry increases with greater cognitive load, we examined mimicry scores as a function of lie task. Figure 3.1 shows upper-body mimicry as a function of task. A regression with curve fitting of Upper-body mimicry on Task type revealed an increase in the amount of interviewer-interviewee mimicry with greater cognitive load, $r = .37$, $F(1, 126) = 20.47$, $p < .001$. Post hoc t-tests revealed that people mimicked more when telling the difficult lie in forward order, $t(62) = -2.78$, $p = .007$, and the very difficult lie in reverse order, $t(61) = -4.16$, $p < .001$, compared to when being truthful.

To determine the generality of this finding, we repeated the analyses using DTW scores from each of the four limbs. These regressions revealed that this linear relationship between mimicry and cognitive load was created by all four body parts: torso $r = .39$, $F(1, 119) = 12.81$, $p = .001$; head $r = .37$, $F(1, 127) = 9.08$, $p = .003$; left hand $r = .35$, $F(1, 127) = 9.35$, $p = .003$; and, right hand $r = .37$, $F(1, 98) = 6.93$, $p = .010$.

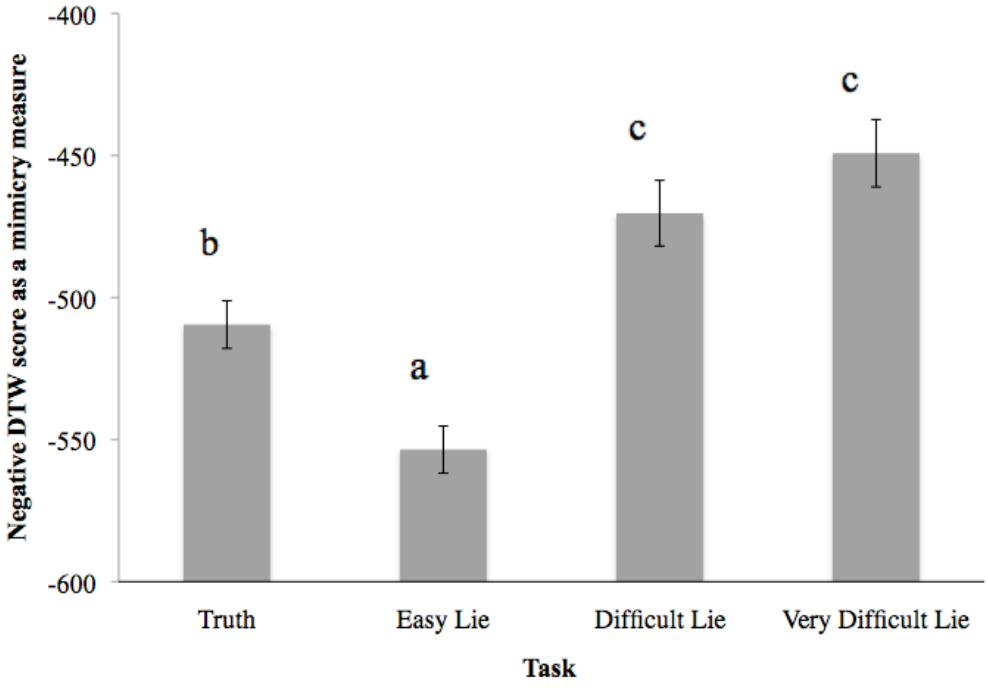

Figure 3.1. Mean negative upper-body DTW values as a function of task in original order (error bars = SE). Different letters indicate significant differences between the conditions, with $p < .05$.

As can be seen from Figure 3.1, interviewer-interviewee mimicry was lower during the easy lie (i.e., concealment) compared to all other tasks: Truth, $t(83) = -3.44$, $p = .001$, difficult lie, $t(63) = -5.84$, $p < .001$; and very difficult lie, $t(62) = -7.14$, $p < .001$. Surprisingly, interviewees mimicked less when concealing information (i.e., the easy lie) compared to when being truthful, suggesting that participants may have

found concealing information the least cognitively demanding task, rather than being truthful. Interestingly, this was consistent with interviewees' self-report difficulty responses. They reported finding the concealing information task (i.e. the easy lie) easier than telling the truth. The combination of the self-reported difficulty and mimicry results emphasize that the original structure of lie difficulty did not match interviewees' perceptions. Thus, these data suggest that the task order I assumed would represent an increase in cognitive load was incorrect, and that a new task order will be a better representation of the data. When an equivalent regression was computed with the corrected task order, a positive linear relationship between cognitive load and mimicry was observed, $r = .58$, $F(1, 127) = 64.65$, $p < .001$. Figure 3.2 shows the effect of Task on mimicry according to the new task order.

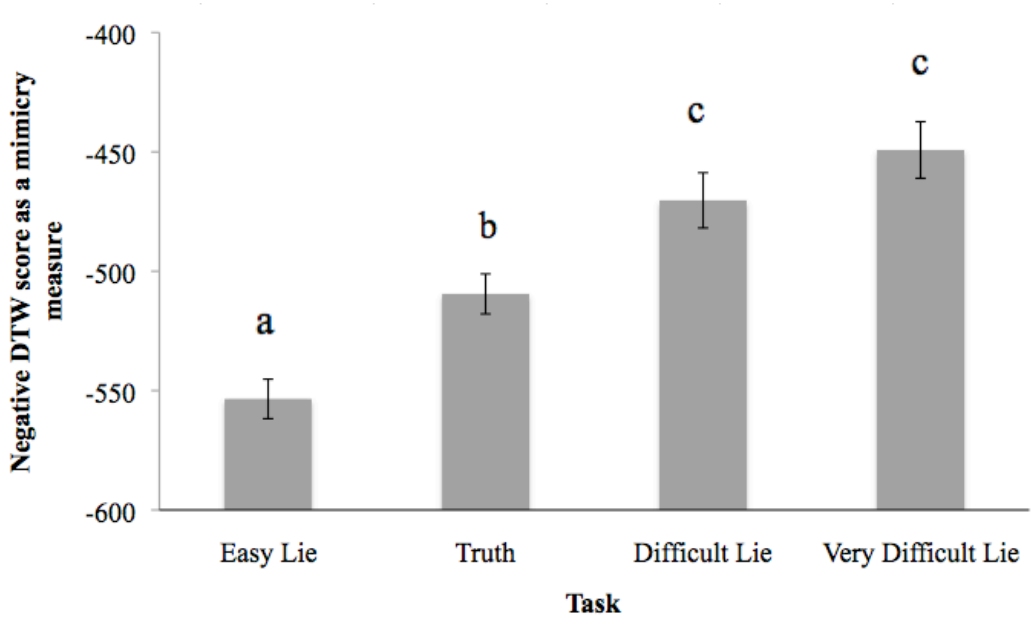

Figure 3.2. Mean negative upper-body DTW values as a function of task in original order (error bars = SE). Letters indicate a significant difference between the conditions, with $p < .05$.

3.5 Discussion

This study is one of the first to examine interpersonal aspects of deceptive behaviour. So far, only Dunbar et al. (2011) have also taken a dyadic approach to deception research with a focus on mimicry occurrence. They revealed that different aspects of verbal, para-verbal and nonverbal mimicry are affected by lying. However, it is still unknown what aspect of lying caused mimicry to differ between truth tellers and liars. The results from this study provide evidence that cognitive load is a factor of influence, as nonverbal mimicry increased with lie difficulty. This finding is consistent with the cognitive load based hypothesis that suggested that interpersonal mimicry may even increase under cognitive load because those processes experience less conscious interference (Van Leeuwen et al., 2009). Although previous research already has connected mimicry increase with greater cognitive load, so far this has only been tested with isolated body parts like finger movement and outside the context of human interaction (Van Leeuwen et al., 2009). This is the first research to show that cognitive load impacts nonverbal mimicry in an interview setting, including hand, torso and head movement.

The findings extend research showing that cues to deception become more pronounced under the cognitive load of reverse order questions (Vrij et al., 2008) by showing that such load also impacts the interpersonal behaviour of liars. It also lends support to the idea that the consequences of cognitive load can be used to distinguish liars from truth tellers. In the study presented here, interviewees were invited to describe truthfully as much as they could remember about an informal conversation and, deceptively, what they could remember about solving a puzzle with a confederate. For these two conditions, the only difference between the two tasks was having to be honest or deceptive about the information in memory. Mimicry differed

between the truth and easy lie provide evidence that mimicry is affected by veracity in a free recall interview.

However, against our expectation, this mimicry difference observed across these conditions went in the other direction; more mimicry occurred when telling truths compared to concealing information (i.e., easy lie). This pattern of behaviour may best be explained by the fact that interviewees reported finding concealing information less cognitively demanding then truth telling. This finding highlights the importance of cognitive load when examining the effect of deception on interpersonal processes. The possibility that concealing information is easier than telling an elaborate truth is consistent with Vrij's (2008) argument that, in some social situations, concealing information (e.g., not mentioning that your partner's new haircut does not look great) or telling a white lie (e.g., telling your partner their new haircut looks great although feeling otherwise) is socially beneficial and can be less difficult than telling the truth (e.g., telling your partner their new haircut is awful). Panagopoulou, Mintziori, Montgomery, Kapoukranidou and Benos (2008) measured the benefits of concealing information over telling the truth in consultation sessions with terminally ill cancer patients. Their results provide experimental evidence to support the view that concealing information can be beneficial to the sender, by showing that doctors experienced less anxiousness, less negative mood and had decreased sympathetic activity when they concealed the diagnosis during their interaction with a patient, compared to disclosure. The results presented by Panagopoulou et al. (2008) suggest that in some situations, concealing information is less difficult than disclosing information, for example when the information has a negative connotation (e.g., a cancer diagnosis and in this study, cheating).

Importantly, both fabrications were perceived to be more difficult and led to more mimicry compared to truths and concealments. To ensure that mimicry differences in further research are not polluted by interviewee's ambiguous responses to concealing information, all following experiments described in this thesis will include at least a truth and fabrication lie. For forensic practice, these results emphasize difficulties associated with lie detection, as lies are often embedded in truths, rather than fabricated from scratch.

By observing the natural occurrence of mimicry during interaction, this study was able to examine changes in mimicry without the interactants' awareness of the true purpose of this study. Although this approach was useful for including the automatic aspect of mimicry, the findings cannot exclude the occurrence of a more conscious form of mimicry. When lying, interviewees may have used mimicry deliberately as a social strategy to increase chances of being liked (Chartrand & Bargh, 1999; Lakin & Chartrand, 2003) and believed (Buller & Burgoon, 1996; Dunbar et al., 2011). As Stel et al. (2009) acknowledge, an interviewer mimicking a liar's behaviour will decrease detection rates, making mimicry a useful strategy for liars. To control for the occurrence of deliberate mimicry, all interviewees were asked post-hoc during the debriefing about their thoughts on the purpose of the study. However, none of the participants mentioned mimicry as the true purpose of the study, and when explained, none of them reported deliberately having used mimicry during the interview. These findings are in line with the mimicry literature, in which the automatic aspect of mimicry is stressed (Bargh & Chartrand, 1999; Heyes, 2011) and suggests that although it might prove effective, liars do not deliberately use mimicry to avoid getting caught.

However, the lack of deliberate attempts to mimic does not exclude other alternative explanations. For example, liars tend to monitor their interaction partners more than truth tellers because they sought to determine whether or not the interviewer believes them (Kassin & Gudjonsson, 2004; Schweitzer et al., 2002). In Chapter four, the effect of attention on mimicry is examined to investigate the possibility that the mimicry differences between truth tellers and liars are caused by a liar's increased monitoring of their interaction partner, rather than increased cognitive load.

3.6 Conclusion

We demonstrated the importance of taking interpersonal processes into account when examining cues to deception. Nonverbal mimicry increases under the cognitive load of lie difficulty, and this effect becomes particularly prominent when interviewees fabricate accounts, especially when done in reverse order. Moreover, our data showed that cognitive load is the driving factor behind the mimicry differences between truth tellers and liars, and show that cognitive load can be actively induced by asking reverse order questions. Interestingly, even without cognitive load manipulations through question type, mimicry differed when interviewees told truths and concealed information in a free recall setting. This paper highlights the importance of taking bidirectional interpersonal processes into account when evaluating deceptive behaviour and proposes the use of automatic analyses of human behaviour to do so.

Chapter Four: **Are you Looking at me? Investigating the Effect of Attention on Nonverbal Mimicry when Lying**

4.1 Abstract

The previous Chapter demonstrated that nonverbal mimicry increased with task difficulty, which was testing in a deceptive context. However, lying does not only differ from truth telling in the amount of required cognitive load, but also affects how much one monitors their interlocutor. To disentangle the effect of attention and cognitive load on mimicry, this Chapter examines the impact of attention and task difficulty on the nonverbal mimicry between interviewer and interviewee. Forty-three interviewees were assigned to one of three conditions, where they received an instruction to pay extra attention to the nonverbal behaviour of the interviewer, the verbal behaviour of the interviewer, or no instruction. They then had to tell the truth about a conversation, conceal that they cheated when solving a puzzle task (easy lie), and fabricated an account about a game of Clue in reverse order (very difficult lie). Results suggested that although interviewees followed their attention instruction, it did not impact mimicry levels. In addition, the positive relation between task difficulty and mimicry was replicated on both upper-body and individual limb data, suggesting that nonverbal mimicry increases under the cognitive load of lying.

4.2 Introduction

The effect of attention on nonverbal mimicry is especially interesting for research on deception because liars may be more motivated than truth tellers to focus on the actions of their interaction partner, since this is the only way in which they can monitor the credibility of their lie (Buller & Burgoon,, 1996; Schweitzer et al., 2002). A consequence of this increased attention could be increased mimicry, which is something that has been observed in relation to facial mimicry (Likowski et al., 2008). Interestingly, this possibility may be compounded by the fact that suspicious interviewers may also have inadvertently increased the attention they paid to the interviewee and his behaviour. This is consistent with evidence suggesting that lying is associated with negative emotions (Bok, 1978; McCornack & Levine, 1990) and that people pay more attention to negative events compared to neutral and positive events (Dijksterhuis & Aarts, 2003). Might the positive correlation between mimicry and cognitive load observed in the previous Chapter be mediated by attention?

Evidence that attention can serve as a mediating variable regarding mimicry is provided by research on individual differences. Two individual differences variables that are associated with attention are self-construal and empathy. First, people differ in the way they define themselves in terms of their relations with others, from a self-focused independent self-construal to an other-focused interdependent self-construal (Markus & Kitayama, 1991). Van Baaren et al. (2003b) found that individuals who naturally had, or were primed with an interdependent self-construal paid more attention to their interlocutor and had a higher natural tendency to mimic them during a task, compared to individuals with a natural or primed independent self-construal. Secondly, the perspective-taking aspect of empathy impacts mimicry (Chartrand & Bargh, 1999). In the third experiment described in their paper, they discovered that

people who scored high on perspective-taking mimicked their interaction partner more than low-perspective takers. Their explanation for this finding was that mimicry is most affected by the individual difference variable that determines how much attention and thought one pays to their interaction partner because a greater perception of the interaction partner leads to more mimicry.

To be sure, the evidence sighted in the previous paragraphs suggests that attention impacts mimicry through individual differences in people's pro-social orientation. However, many behaviours, especially automatic ones, that are caused by individual differences have been demonstrated to be consistent across situations (Furr & Funder, 2004). Thus, it is not unreasonable to assume that attention levels caused by individual differences will be relatively stable over time and across situations, including in the pro-self scenario of telling a lie.

4.2.1 Current study.

To examine the impact of attention on mimicry, we conducted a second experiment in which we compared the behaviour of interviewees whose attention to the interviewer's behaviour was manipulated. Specifically, interviewees were instructed either to pay extra attention to the interviewer's nonverbal behaviour, pay extra attention to the interviewer's verbal behaviour, or they received no instruction. Both the verbal instruction and no instruction groups served as controls to the manipulation of interest, namely, the nonverbal group. Using both groups made it possible to separate out the actual effect of attention to nonverbal behaviour and the effect of increased cognitive load caused by adding another task (i.e., having to follow instructions).

The results described in Chapter 3 suggest that mimicry increases with cognitive load. If following instructions in general is more difficult than not having to

follow instructions (i.e. having to follow instructions increases cognitive load), mimicry in the nonverbal and verbal instruction condition will be higher than mimicry in the no instruction condition (H1). By contrast, if attention is driving the mimicry effect, then mimicry in the nonverbal attention condition but not the verbal attention condition will be higher than the no instruction condition (H2).

4.3 Method

4.3.1 Participants.

Eighty-six students acted as the interviewee or the interviewer (Age M = 21.1 yrs, Range 18-32). Interviewees (n = 43) received payment of £8 for 70 minutes of their time. Interviewers (n = 43) received £5 for 40 minutes of their time. One pair had to be excluded from the sample because of technical problems with the motion recording, leaving 42 pairs.

4.3.2 Procedure.

The current study replicated the study design described in Chapter 3, but with three changes. First, in order to manage the design complexity of the study, the difficult lie condition (i.e., answering questions in forward order) was removed. The findings of Chapter 3 suggest that the three remaining conditions are sufficient to allow a test of the hypotheses. Second, before entering the interviewing room, interviewees were randomly allocated to one out of three instruction conditions. These instructions, which were provided both verbally and in writing, asked interviewees to either: i) “pay extra attention to the nonverbal behaviour of the interviewer”; ii) “pay extra attention to the verbal behaviour of the interviewer,” or, iii) they did not receive an instruction. Third, in order to provide a check of the attention manipulation, an extended version of the post-task questionnaires was used. For the interviewee, the additional items asked interviewees to rate, using a Likert scale ranging from ‘not at

alll' (1) to 'very much' (7), "the extent to which they experienced difficulty following the instructions," and, "the amount of attention they paid to 'the interviewer's nonverbal behaviour' (1) versus 'the interviewer's verbal behaviour' (7)." For the interviewer participant, these statements concerned how much they believed the interviewee was distracted, and how much attention the interviewee was paying to their nonverbal and verbal behaviour.

4.3.3 Measuring nonverbal behaviour.

Data were collected and analysed with the use of eight WiTilt devices in the same way as the study described in Chapter 3.

4.4 Results

4.4.1 Manipulation checks.

The post-task questionnaires confirmed that the instruction led to differences in the experiences of the interviewee and interviewer. A 3 (Instruction) x 3 (Task) mixed ANOVA revealed that attention for the interviewer was influenced by attention instruction, $F(2, 117) = 9.05$, $MSE = 1.68$, $p < .001$, $\eta^2 = .13$, but not by task, $F(2, 117) = .04$, $MSE = 1.68$, $p = .97$, $\eta^2 = .00$. Interviewees in the nonverbal instruction condition reported paying more attention to the interviewer's nonverbal behaviour ($M = 3.53$, $SD = 1.30$) compared to interviewees in the verbal ($M = 4.55$, $SD = 1.21$), $t(76) = -3.58$, $p = .001$, and no instruction condition ($M = 4.67$, $SD = 1.37$), $t(82) = -3.85$, $p < .001$. Interviewees in the verbal attention instruction group reported paying more attention to verbal behaviour compared the nonverbal instruction group $t(76) = 3.58$, $p = .001$. No attention difference was found between interviewees in the verbal and no instruction condition, $t(88) = -.43$, $p = .666$, and no interaction effect between task and attention instruction was found, $F(4, 117) = 1.56$, $MSE = 1.68$, $p = .189$, η^2

= .04. In addition, a Pearson correlation revealed no association between attention instruction and mimicry, r = -.02, n = 124, p = .87.

The post-hoc measures also confirmed that the task manipulation impacted on the interviewees' experiences. Interviewees reported finding the tasks increasingly more difficult, from truth (M = 2.00, SD = 1.21), easy lie (i.e., concealment lie; M = 2.62, SD = 1.40), and very difficult lie in reverse order (i.e., fabrication in reverse order; M = 4.45, SD = 1.61), $F(2, 117) = 32.54$, MSE = 2.02, $p < .001$, $\eta^2 = .35$. They also reported feeling increasingly more anxious across tasks, from truth (M = 2.38, SD = 1.38), easy lie (M = 2.60, SD = 1.31), and very difficult lie in reverse order (M = 4.31, SD = 1.62), $F(2, 117) = 22.12$, MSE = 2.11, $p < .001$, $\eta^2 = .27$. Finally, interviewees reported feeling increasingly less confident, from truth (M = 5.57, SD = 1.29), easy lie, (M = 5.40, SD = 1.27), and very difficult lie in reverse order, (M = 3.57, SD = 1.48), $F(2, 117) = 28.58$, MSE = 1.83, $p < .001$, $\eta^2 = .32$. Three Pearson correlations of self-reported Difficulty, Anxiety and Confidence on mimicry revealed that mimicry was correlated with an interviewees' self-reported difficulty, r = .40, n = 124, p < .001, with self-reported anxiety, r = .30, n = 124, p = .001 and self-reported confidence, r = -.37, n = 124, $p < .001$.

As part of the post-task questionnaire, interviewers were asked to judge, on a Likert scale ranging from 'not at all' (1) to 'very much' (7), how much they felt that the interviewee was paying attention to what they were saying and how they were behaving. This information provided the opportunity to check whether or not interviewers were aware of the instruction given to the interviewees. Two 3 (Instruction) x 3 (Task) mixed ANOVA were performed with the interviewer's perceptions of the interviewee's attention for their nonverbal and verbal behaviour.

For both verbal and nonverbal behaviour, task type and instruction did not affect the interviewer's perceptions, indicating that interviewers were neither aware of the attention instructions given to the interviewees, nor did it affect the interviewer's perception of task (Nonverbal, Task: $F(2, 117) = .17$, $MSE = 2.02$, $p = .841$, $\eta^2 = .00$; Nonverbal, Instruction: $F(2, 117) = 2.27$, $MSE = 2.02$, $p = .108$, $\eta^2 = .04$; Verbal, Task: $F(2, 117) = .07$, $MSE = 1.51$, $p = .934$, $\eta^2 = .00$; Verbal, Instruction: $F(2, 117) = .50$, $MSE = 1.51$, $p = .606$, $\eta^2 = .01$).

As before, interviewers were asked to judge for each topic if the interviewee was being truthful or not. This served as a manipulation check for cognitive load, since research has shown that more difficult lies are easier to detect than easy lies, an effect accompanied by an increase in lie bias when detecting more difficult lie (Vrij et al., 2008). In line with the detection rates from Chapter 3, a chi square analysis, revealed a significant association between lie difficulty and detection rates, $X^2 (1) = 4.94$, $p = .026$, $\Phi = .24$. Interviewers more often correctly identified the very difficult lie (52% correct) compared to the easy lie (29% correct), which may have been caused by increased interviewer suspicion. They were also more accurate at correctly identifying truths (74% correct) than they were at identifying the lies in general (40% correct), $X^2 (1) = 12.46$, $p < .001$, $\Phi = -.31$. Two Pearson correlations revealed that mimicry was not significantly associated with correct detection ($r = -.04$, $n = 124$, $p = .668$) nor veracity judgment ($r = -.12$, $n = 124$, $p = .177$; i.e., the interviewers' suspiciousness).

4.4.2 Mimicry.

Based on the self-reported difficulty results from Chapter 3, the new difficulty task order (i.e., from easy lie, to truth, to very difficult lie in reverse order) was used

to measure the influence of task and attention instructions on mimicry. Figure 4.1 shows full-body mimicry as a function of instruction and task. A 3 (Attention instruction) x 3 (New Task type) mixed ANOVA with New task as the repeated measure and Upper-body DTW score as the dependent variable revealed a main effect for New task, $F(2, 115) = 30.90$, $MSE = 2250.37$, $p \prec .001$, $\eta^2 = .34$, but not for both the Attention instruction, $F(2, 115) = .11$, $MSE = 2250.37$, $p = .899$, $\eta^2 = .00$. and the interaction between New task and Attention instruction, $F(4, 115) = .81$, $MSE = 2250.37$, $p = .519$, $\eta^2 = .02$. Regardless of attention instruction, mimicry increased with task difficulty. More mimicry occurred when interviewees were telling the very difficult lie in reverse order compared to the truth, $t(81) = 5.17$, $p < .001$, and compared to the easy lie, $t(80) = 8.23$, $p < .001$. In addition, mimicry also differed between the truth and the easy lie, with more mimicry occurring during the truth compared to the easy lie, $t(81) = 2.32$, $p = .023$.

To examine the cause of this task difficulty effect on mimicry in more detail, four equivalent ANOVAs were conducted for head, torso and wrist movement. There was a significant Task effect for all body parts: torso $F(2, 109) = 7.70$, $MSE = 3886.52$, $p = .001$, $\eta^2 = .12$, head $F(2, 113) = 10.66$, $MSE = 3259.95$, $p < .001$, $\eta^2 = .16$, left hand $F(2, 114) = 17.15$, $MSE = 6943.87$, $p < .001$, $\eta^2 = .23$, and right hand movement $F(2, 114) = 24.88$, $MSE = 5277.72$, $p < .001$, $\eta^2 = .29$.

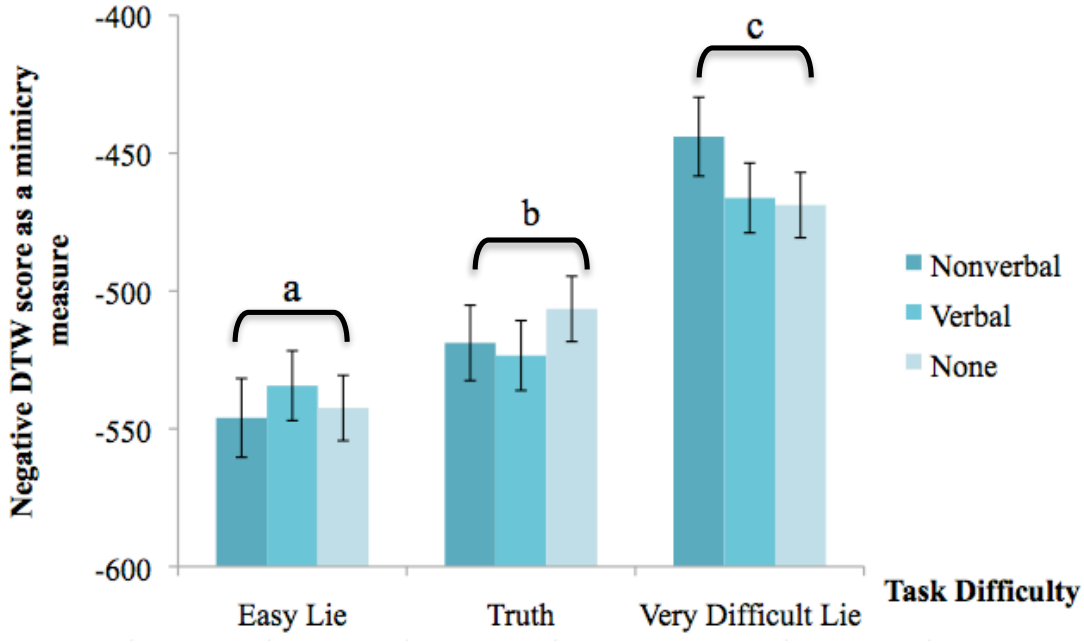

Figure 4.1. Mean negative upper-body DTW values as a function of task and attention instruction in new order (error bars = SE). Letters indicate a significant difference between the conditions, with $p < .05$.

4.5 Discussion

This Chapter sought to determine whether or not changes in attention accounted for the increase in nonverbal mimicry found in Chapter 3. Evidence that attention can mediate the occurrence of mimicry was provided in the individual differences literature. Both having an interdependent self-construal and being empathetic have been found to increase mimicry through increased attention for the interaction partner (Chartrand & Bargh, 1999; Van Baaren et al., 2003b). However, if mimicry differs within the same individual when telling truths and lies, as was found in Chapter 3, the effect context-related attention has on mimicry is of higher relevance. To this end, interviewees were instructed to pay extra attention to the verbal or nonverbal behaviour of their interaction partner, or they did not receive any such instruction. Although interviewees reported paying more attention to the

behaviour identified in their instructions, this did not impact the degree of interviewer-interviewee mimicry. As a consequence, although individual differences in attention paying may impact mimicry, situational-dependent attention does not. This led to the rejection of Hypotheses 1 and 2. Importantly, the results did provide evidence confirming the results presented in Chapter 3, seen as the extent of nonverbal mimicry did increase with lie difficulty irrespective of the focus of attention of the interviewees. As before, more mimicry occurred from the easy lie (i.e., concealment), to the truth and to the very difficult lie in reverse order (i.e., fabrication in reverse order). This rules out the alternative explanation that mimicry increased due to raised lying-related attention in both interaction partners.

Interestingly, while interviewees from the current study and the study of Chapter 3 were consistent in their nonverbal mimicry, their perception of task difficulty was not consistent. Although interviewees in both Chapters found fabricating information the most difficult task and consequently increased their coordination, the results in the truth and concealment condition were less consistent. In Chapter 3, interviewees found concealing information easier than telling the truth, while in this study, interviewees found concealing information more difficult than truth telling. These conflicting self-reports occurred although participants followed the same procedure in both studies. This suggests that although fabricating an account is substantially more difficult than truth telling with the subsequent behavioural consequences, difficulty differences between truths and concealment lies are much more subtle. This discrepancy between perception and behaviour is of especial interest when attempting to detect deceit because even though someone might not subjectively experience concealing information differently than being truthful, objective measurements still reveal changes in their interpersonal behaviour.

The underlying driver for this study to look at attention was because liars tend to not take their credibility for granted and may seek to gain feedback from their interviewer (Kassin & Gudjonsson, 2004). However, both interviewees' self-reported attention levels and interviewers' awareness of attention paid to them by interviewees was not found to be a function of lie type, suggesting that participants did not raise attention when lying or being lied to, respectively. This finding is contrary to suggestions from the existing literature on increasingly monitoring the interaction partner's behaviour when lying (Schweitzer et al., 2002). However, support for this finding is provided by the meta-analysis by DePaulo et al. (2003). Although not the optimal measure, eye contact and gaze aversion should provide some indication of attention levels. Interestingly, the meta-analysis revealed that both eye contact (d = .01) and gaze aversion (d = .03) were not significantly correlated with deception in lab settings (DePaulo et al., 2003) and in real life situations (Mann, Vrij, & Bull, 2002). The current results in combination with the meta-analysis by DePaulo et al. (2003) suggest that there is no difference in attention for the interaction partner between truth tellers and liars, while the opposite has also been demonstrated in the deception literature (Buller & Burgoon, 1996; Schweitzer et al., 2002). This discrepancy is interesting for future research.

Lying was hypothesized to not only affect attention levels from the liar's perspective, but the negative connotation of lying and people's tendency to pay more attention to negative events (Dijksterhuis & Aarts, 2003) was expected to increase attention from the interviewer when suspecting to be lied to. However, interviewers' veracity judgments did not impact mimicry, providing further evidence that mimicry was not impacted by raised attention from either the interviewer or interviewee, eliminating the alternative explanation proposed in this study.

This Chapter supports the previous findings from Chapter 3 by showing that the interpersonal dynamics of a conversation change depending on people telling truths, concealments and fabrications. Importantly, self-reported difficulty as a measure of cognitive load was again significantly correlated with mimicry, providing further support for the cognitive explanation. This association between cognitive load and mimicry has been proven to differentiate between truths and lies in a homogeneous setting, but what happens when other cognitive load imposing factors unrelated to deception play a role? For example, speaking in a second language is both associated with an increase in cognitive load and behavioural changes (Cheng & Broadhurst, 2005; Marcos, 1979), which subsequently could affect mimicry occurrence. In Chapter five, the effect of second language use on mimicry is examined to investigate if other cognitive load imposing factors disrupt the previously found mimicry differences between truth tellers and liars.

4.6 Conclusion

The aim of the current study was to investigate if mimicry was mediated by attention levels, but the results suggest that mimicry occurrence was not associated with attention. We did replicate the findings that were previously presented in Chapter three, by showing that mimicry increases with task difficulty in a deceptive setting. Again, we found evidence that this increase in mimicry was associated with increased cognitive load. Highest mimicry levels were found during the interview part about the most difficult task of the experiment, which comprised of fabricating an account in reverse order. This chapter highlights the impact cognitive load has on mimicry and how this can be used to detect deceit, especially when the liar is fabricating information.

Chapter Five: **Nonverbal Mimicry Increases in Second-Language Speakers**

5.1 Abstract

This Chapter examines the extent to which liars and truth-tellers mimicked the nonverbal behaviour of their interviewer whilst answering questions in their first or second language. Interviewee participants were asked to either tell the truth or lie about two experiences: an informal conversation in which the experimenter appeared to break University rules, and one or two rounds of the board game 'Guess who?'. While truth-tellers told the truth about both experiences, liars were asked to conceal the experimenter's transgression and fabricate their experience of the board game. In line with previous research, interviewees speaking in their first language showed more nonverbal mimicry when lying compared to when telling the truth. However, the opposite effect was found for second language speakers, who mimicked less when lying compared to when telling the truth. In addition, second language speakers mimicked more regardless of veracity compared to first language speakers. These results may be explained with reference to the importance of 'mother tongue' to the cognitive load experienced at interview.

5.2 Introduction

How lying impacts nonverbal mimicry was examined in Chapters Three and Four, where participants told a truth and lies of increased difficulty. The results showed that mimicry increased with task difficulty, with highest mimicry levels occurring when interviewees told the most complex lie (i.e., a fabrication recalled in reverse order). This finding can be explained through an increase in importance of automatic processes when cognitively taxed. Evidence for this theory has been provided by Van Leeuwen et al. (2009), who found that, especially when cognitively loaded, people move their finger more quickly in response to a finger cue compared to a spatial cue. The increase of mimicry under cognitive load is relevant when examining mimicry differences between truth tellers and liars because lying can be more cognitively taxing than truth telling (Cheng & Broadhurst, 2005; DePaulo et al., 2003; Vrij, 2008; Vrij et al., 2010). This difference in cognitive load between truths and lies is caused by different principles, such as an increase in stakes when one is lying, caused by the negative consequences of being caught. Other factors of influence are the difficulties associated with formulating a lie whilst remembering the truth and sticking to the story within making slips of the tongue (DePaulo et al., 2003; Kassin & Gudjonsson, 2004; Vrij, 2008; Spence et al., 2001; Vrij et al., 2010). Additionally, type of lie also impacts how cognitively taxing lying is, with fabrications being more difficult than concealments (Chapter 3, 4; Vrij & Heaven; 1999). The results described in Chapters Three and Four show that type of lie not only affects experienced difficulty by the interviewee, but subsequently impacts on nonverbal mimicry as well. A deception detection benefit of mimicry being impacted by cognitive load is that it can help distinguishing between truth tellers and liars. More specifically, interviewers can actively induce cognitive load in the interviewee

by using questioning techniques that are used to enlarge behavioural differences between truth tellers and liars, such as asking specific, unanticipated (Vrij et al., 2009) and reverse order questions (Vrij et al., 2008). However, a possible disadvantage is that other, non-deception related, individual or contextual factors induce an interviewee's cognitive load, disrupting natural mimicry differences between truth tellers and liars.

A factor that is both forensically relevant and has been associated with increased load is second language use. Police forces increasingly need to interview suspects in a second language (Cheng & Broadhurst, 2005), which is of forensic relevance because second language use is associated with behavioural changes, such as facial expressions (Cheng & Broadhurst, 2005) and gesturing (Marcos, 1979). These behavioural changes are accompanied by two distinct factors that may occur when speaking in a second language, increased cognitive load and 'foreign language anxiety'.

First, Da Silva and Leach (2011) hypothesized that speaking in a second language may be more cognitively demanding than speaking in one's native tongue, because people have to inhibit neural control mechanisms when speaking in their second, rather than first language (Wang, Xue, Chen, Xue, & Dong, 2007). A second reason that second language use can be more cognitively demanding than first language use is the increased likelihood of experiencing the split-attention effect, which occurs when encountering an unfamiliar word. Now attention is divided between two sources instead of one; the original source and the source that will help explaining the unknown word (Chandler & Sweller, 1991, 1992). Although the split-attention effect can also occur when encountering new or difficult words in ones first language, its occurrence is likely to be more frequent during second language use. An

increase in cognitive load during second language use has also been found in a deception context. Cheng and Broadhurst (2005) showed that Cantonese people found it easier to lie in their first language, compared to lying in their second language. As a consequence, both lying and second language use can induce cognitive load, with the possible consequence of increased nonverbal mimicry.

A second way in which second language use can affect mimicry is via the occurrence of 'foreign language anxiety' (Caldwell-Harris & Aycicegi-Dinn, 2009; Horwitz et al., 1986). Foreign language anxiety is the occurrence of tension, nervousness, worry and anxiety caused by second language use (Horwitz et al., 1986). This anxiety is not limited to learning a second language but it can also occur when speaking in a second language. For example, Caldwell-Harris and Aycicegi-Dinn (2009) demonstrated that both lying and speaking in a second language independently increased participants' arousal at interview. Arguably, lying related arousal was caused by emotions associated with lying, while second language related arousal was caused by anxiety about managing speech production in a foreign language. These results indicate that both lying and second language use will impact an interviewee's emotions, and especially induce anxiety. The anxiety related to second language use has been found to impact nonverbal behaviour, causing an increase in self-manipulators, averted eye gaze and nervousness (Gregersen, 2005). These behavioural consequences could lead to a mismatch in behaviour between the interviewer and interviewee, disturbing the interpersonal processes, and ultimately reducing interviewer-interviewee mimicry.

Both the cognitive load and foreign language anxiety accounts described above are examples of factors that likely have a direct effect on interpersonal processes. However, as Interpersonal Deception Theory (IDT; Buller & Burgoon,

1996) identifies, interpersonal processes may also be affected indirectly. In second language interviews, an interviewer's suspicion may be raised by factors that are not related to the interviewee's deceit. Specifically, when comparing first and second language interviews, interviewers perceived second language speakers to be more deceptive regardless of veracity than first language speakers (Cheng & Broadhurst, 2005; Da Silva & Leach, 2011). The indirect effect of such a lie bias will mean that interviewers of second language speakers may tend to approach their interaction with hesitant, suspicious behaviour (Cheng & Broadhurst, 2005). This can have a twofold effect on mimicry. First, since mimicry is influenced by having positive feelings towards the interaction partner, the result of this negative presentation form the interviewer is likely a reduction in mimicry levels. The interviewee may 'sense' the suspicion in the interviewer and conscious or unconsciously change his or her nonverbal behaviour accordingly. This mimicry reduction would occur when speaking in a second language regardless of veracity. Second, interviewer suspicion may increase mimicry because interviewees can try to use mimicry to increase their credibility (Dunbar et al., 2011).

5.2.1 Current study.

The current study examined the influence of second language use on interviewer-interviewee nonverbal mimicry across four conditions: i) truth-telling in interviewees' first language; ii) lying in interviewees' first language; iii) truth-telling in interviewees' second language; and, iv) lying in interviewees' second language. On the basis of previous research it was hypothesized that the occurrence of both cognitive load and second language anxiety can have a direct and indirect effect on interpersonal processes. Based on the previous studies of this thesis, a dominant impact of cognitive load was predicted. Specifically, it was predicted that more

mimicry would occur during second language interviews compared to first language interviews (H1) and that more mimicry would occur during deceptive interviews compared to truthful interviews (H2). Additionally, most mimicry was expected to occur during deceptive interviews performed in the interviewees' second language (i.e., the most difficult interview setting; H3).

5.3 Method

5.3.1 Participants.

Fifty-six students from the University of Twente (*M* Age = 22.0 yrs, Range 18 – 31, Males = 38) volunteered to participate as either an 'interviewee' or 'interviewer.' Interviewees (*n* = 28) were paid €7 for participation in a pre-interview task and subsequent interview that took approximately 70 minutes. Interviewers (*n* = 28) were paid €5 for participation in the interview, which took approximately 40 minutes. All participants were Dutch and spoke Dutch as their first language.

5.3.2 Procedure.

The experiment comprised a pre-interview stage that involved the interviewee participants, and an interview stage that involved both the interviewer and interviewee participants. As we describe below, half of the participants performed the entire study in their first language (Dutch) while the other half participated in their second language (English). Within each of these two language conditions, half of the interviewees were required to lie during interview while the other half were required to tell the truth.

5.3.2.1 Pre-interview.

Interviewees completed two increasingly complex tasks designed to differ in the degree of cognitive load they required the interviewees to exert at recall. In Chapters 3 and 4, participants told lies of increasing difficulty, but they only told one

truth. This is problematic because cognitive load inducing strategies may not only increase cognitive load in liars, but also in truth tellers. To address this, the current study utilised a design in which both truths and lies differed in their difficulty. Difficulty was manipulated by both the nature of the task and question type. Task difficulty was manipulated by having interviewees first describe an informal conversation, about which liars had to conceal some information, and then describe what happened during a complex game of 'Guess who?' (see below for more details). This manipulation sought to induce different levels of cognitive load because fabricating a story is more cognitively demanding than concealing information (Vrij & Heaven, 1999). Moreover, to ensure that the game task was perceived to be distinctively more difficult than the conversation task, interviewees were asked to recall game task in reverse order. Answering questions in reverse order has been shown to increases the cognitive load associated with providing an account, particularly for liars (Vrij et al., 2008).

The first informal conversation task involved conversation with the experimenter. Halfway through the conversation, whilst explaining that she was currently marking some essays, the experimenter faked realising that she had left the essays in a lecture theatre that morning. She then excused herself and rushed out of the room to pick them up. On return, she showed the essays to the interviewee and expressed relief that they had been recovered. For interviewees in the truth condition, she then went on to indicate that, while the incident was embarrassing, it was appropriate for them to tell the interviewer everything that had happened. By contrast, for interviewees in the lie condition, she indicated that she had just started working at the University and that it would look terrible if her supervisor found out she had lost the essays. As their interview would be videotaped, she would prefer to not have this

incident covered on video, since her supervisor would review the videos. She then asked the interviewees to not mention the incident during the interview. The conversation then continued for a few minutes after which the experimenter explained the second task. This task was chosen because it involved hiding incriminating knowledge when being interviewed, which is a situation often encountered during police interviews.

The second task involved the interviewee and experimenter playing a game of 'Guess who?'. Interviewees in the truth condition played the game for approximately 10 minutes, and were instructed to tell the truth about the game during the interview. To help ensure an equivalence of experience, the experimenter checked how long the first game had lasted and, if it was less then 7 minutes, initiated a second game so that all participants experiences 10 minutes of playing. Games were never stopped halfway through, and the second round was typically completed faster. The experimenter did not manipulate winning or losing during the game. She initiated game-related conversation from time to time, but did respond to questions from the participant about other conversation topics.

Interviewees in the lie condition did not play the game but instead had 10 minutes to prepare a story about how they would have played the game with the experimenter. During the lie preparation, the game was displayed at the table in front of the participant to familiarize them with the game. The 'Guess wo?' game was chosen due to the nature of the game. It involves players to describing facial features and ways to recognize people. In addition, the order of events is of importance, adding a time aspect when describing how the game was played. Both game aspects are relevant in a forensic setting. In general, interviewees in both conditions got told

before entering the interview that their name would be put in a prize draw for an iPod Shuffle if they could convince the interviewer that they were telling the truth.

5.3.2.2 Interview.

After finishing the pre-interview tasks, the experimenter met the interviewer outside of the interview room and explained: "There is a participant in this room who has been there for a while. You are going to ask him/her questions about two topics, a conversation and a game of 'Guess who?'. I will give you the lists of questions that I want you to ask. Please do not ask any extra questions, just read the questions on the sheet out loud. After you have asked all questions about a topic, I want you to decide if you think the participant is telling the truth or not. You will be asked to give your opinion, and provide some additional information on a post-task questionnaire." On consenting to take part, the interviewer was invited into the interview room, introduced to the interviewee, and both participants were helped into full-body Xsens MVN motion capture suits (see Chapter 2).

Once set up, the experimenter gave the interviewer a set of questions about the informal conversation, which were: (1) Please first of all tell me all about your conversation with the experimenter; (2) What did the experimenter and you discuss at the start of your conversation?; (3) Can you tell me everything that the experimenter told you about herself?; (4) Was the experimenter with you in the room all the time?; and, (5) How did the conversation end?

Once interviewers were provided with the first set of questions, the experimenter retreated to a corner of the room where she sat with her back towards the participants, in order to monitor the motion recording. Once all questions about the first topic were asked, the experimenter asked both participants to complete a post-task questionnaire. The questionnaire comprised six (for the interviewee) or

seven (for the interviewer) items on which participants were asked to rate their agreement from ‘not at all’ (1) to ‘very much’ (7), For the interviewees, the following statements were used: (1) I found this section of the interview difficult; (2) I felt anxious during this section of the interview; (3) I am confident that I convinced the interviewer that I was telling the truth; (4) I would describe this part of the interview as appropriately paced; (5) I would describe this part of the interview as awkward; and, (6) I found describing things difficult in this language. For the interviewers, the following statements were used: (1) I believe that the participant told the truth in this section; (2) I would describe this part of the interview as awkward; (3) I would describe this part of the interview as appropriately paced; (4) I felt that the participant was trustworthy; (5) I felt that the participant was honest; (6) I felt that the participant was suspicious; and, (7) I felt that the participant was distracted.

Once both participants had completed this post-task questionnaire, the interviewer was provided with a set of questions related to the second task, and the cycle was repeated. The questions asked by the interviewer for the ‘Guess who?’ protocol were: (1) Please tell me how you played the game ‘Guess Who?’ with the experimenter, but in reverse order. Therefore you start with how the game ended and describe the events in reverse order; (2) How did the game end?; (3) How did you think you were doing compared to the other player mid-game?; (4) What questions did you ask to find out who the target was?; and, (5) What happened in the first few moments of the game?

The order in which the topics were addressed was counterbalanced, with half of the interviews starting with the informal conversation questions and half with the ‘Guess who?’ questions. As can be seen above, all the interview questions were open-ended to elicit detailed responses, except for question four from the information

conversation. This question was deliberately constructed as a closed question, to ensure that all interviewees in the lie condition told one outright lie in addition to concealing information. The nature of the questions was based on the questions used in Chapter 3 and 4.

5.3.3 Measuring nonverbal mimicry.

During the interview, full-body motion was measured using two Xsens MVN motion capture systems. Because participants were seated at a table and could not see each other's legs, only upper-body data was used to measure nonverbal mimicry. See Chapter 2 for a full description of the automatic measurement and analysis of nonverbal mimicry with the use of two Xsens MVN suits.

5.4 Results

5.4.1 Manipulation checks.

The post-task questionnaire measures provided us with the opportunity to investigate how participants experienced the interview. A 2 (Task) x 2 (Veracity) x 2 (Language) mixed ANOVA on self-reported difficulty, with task as the repeated measure revealed a main effect for Veracity. Interviewees reported finding lying (M = 4.11, SD = 1.34) more difficult than truth telling (M = 2.93, SD = 1.31), $F(1, 24)$ = 7.00, MSE = 2.780, p = .041, η^2 = .22. This effect, however, was subsumed by an interaction between veracity and task difficulty, with interviewees reporting a greater difference in experience for the more complex 'Guess who?' task (Lying: M = 4.64, SD = 1.28; Truth-telling: M = 2.86, SD = 1.51) than for the informal conversation (Lying: M = 3.57, SD = 1.40; Truth-telling: M = 3.00, SD = 1.11), $F(1, 24)$ = 5.32, MSE = 2.780, p = .030, η^2 = .16. No main effects for Task, $F(1, 24)$ = 3.02, MSE = 2.780, p = .091, η^2 = .09, and Language, $F(1, 24)$ = .16, MSE = 2.780, p = .692, η^2 = .01, were found. In other words, a comparison of these scores across language

conditions revealed no differences in experience between those who spoke their first or second language. Two Pearson correlations of self-reported difficulty on mimicry for both tasks revealed that mimicry and difficulty were not significantly correlated during the Informal conversation, r = .-04, n = 28, p = .840, and not during the 'Guess who?' game, r = -.15, n = 28, p = .453.

A similar pattern was observed for interviewees' experiences of anxiety, but here language did affect anxiety. A 2 (Task) x 2 (Veracity) x 2 (Language) mixed ANOVA on self-reported anxiety, with task as the repeated measure revealed interviewees reporting being more anxious when lying (M = 3.32, SD = 1.61) compared to when telling the truth (M = 1.64, SD = .69), F(1, 24) = 25.20, MSE = 1.565, p < .001, η^2 = .40, and they reported feeling more anxious when speaking in their second language (M = 2.90, SD = 1.69) compared to their first language (M = 2.07, SD = 1.15), F(1, 24) = 6.03, MSE = 1.565, p = .022, η^2 = .09. Interestingly, an interaction effect between veracity and language was also revealed, with liars speaking in their second language feeling more anxious (Lying M = 4.22, SD = 1.30; Truth-telling M = 1.57, SD = .65) than liars speaking in their first language (Lying M = 2.43, SD = 1.41; Truth-telling M = 1.71, SD = .76), F(1, 24) = 8.32, MSE = 1.565, p = .008, η^2 = .13. Two Pearson correlations of self-reported anxiety on mimicry for both tasks revealed that mimicry and anxiety were not significantly correlated during the Informal conversation, r = .09, n = 28, p = .641, and not during the 'Guess who?' game, r = -.07, n = 28, p = .741.

5.4.2 Detection rates.

As part of the post-task questionnaire, for each topic, interviewers were asked to judge the truthfulness of the interviewee's statement. When talking about the

'Guess who?' game, interviewers were better at judging truths (detection rate: 79%) than detecting lies (14%; X^2 (1) = 11.63, p = .001, Φ = -.29). However, this difference in detection rates for truths (detection rate: 57%) and lies (detection rate: 29%) was not found for the informal conversation topic, X^2(1) = 2.33, p = .127, Φ = -.65. In addition, language use did not affect detection rates, neither for the informal conversation, X^2(1) = .00, p = 1.000, Φ = .00, nor for the 'Guess who?' game, X^2(1)= .14, p = .705, Φ = .07. Irrespective of the veracity condition, when talking about the informal conversation, interviewers judged people speaking in their second language more often to being truthful (92%) compared to first language speakers (42%; X^2 (1) = 6.75, p = .009, Φ = -.53). These results were not found for the 'Guess who?' game, where interviewees were not judged as being more or less truthful depending on the language they spoke, X^2 (1) = .38, p = .538, Φ = -.13). Four Pearson correlations were calculated to measure the correlation between mimicry and detection rates and veracity judgment for both tasks. Results revealed that for the informal conversation, both detection rates (r = .28, n = 28, p = .143), and tending towards truth or lie judgments (r = -.30, n = 24, p = .158), were not significantly correlated with mimicry. Similarly, for the 'Guess who?' game, both detection rates (r = .02, n = 28, p = .939), and tending towards truth or lie judgments (r = -.21, n = 23, p = .337), were also not significantly correlated with mimicry. So in conclusion, neither detection rates nor a truth-lie judgement impacted mimicry occurrence.

5.4.3 Nonverbal mimicry.

Figure 5.1 shows the mean negative upper-body DTW scores as a function of veracity and language. A 2 (Task) x 2 (Veracity) x 2 (Language) mixed ANOVA with Task as the repeated measure revealed a Veracity x Language interaction, with participants speaking in their first language mimicking more when lying compared to

truth telling, whilst participants speaking in their second language mimicking more when truth telling compared to lying, $F(1, 24) = 4.88$, $p = .037$, $\eta^2 = .13$. In addition, a main effect was found for language, with participants speaking in their second language ($M = -3.11$, $SD = .96$) mimicking more than those speaking in their first language ($M = -3.77$, $SD = .90$), $F(1, 24) = 7.90$, $p = .010$, $\eta^2 = .21$. No main effect for veracity was found, $F(1, 24) = .72$, $p = .405$, $\eta^2 = .02$.

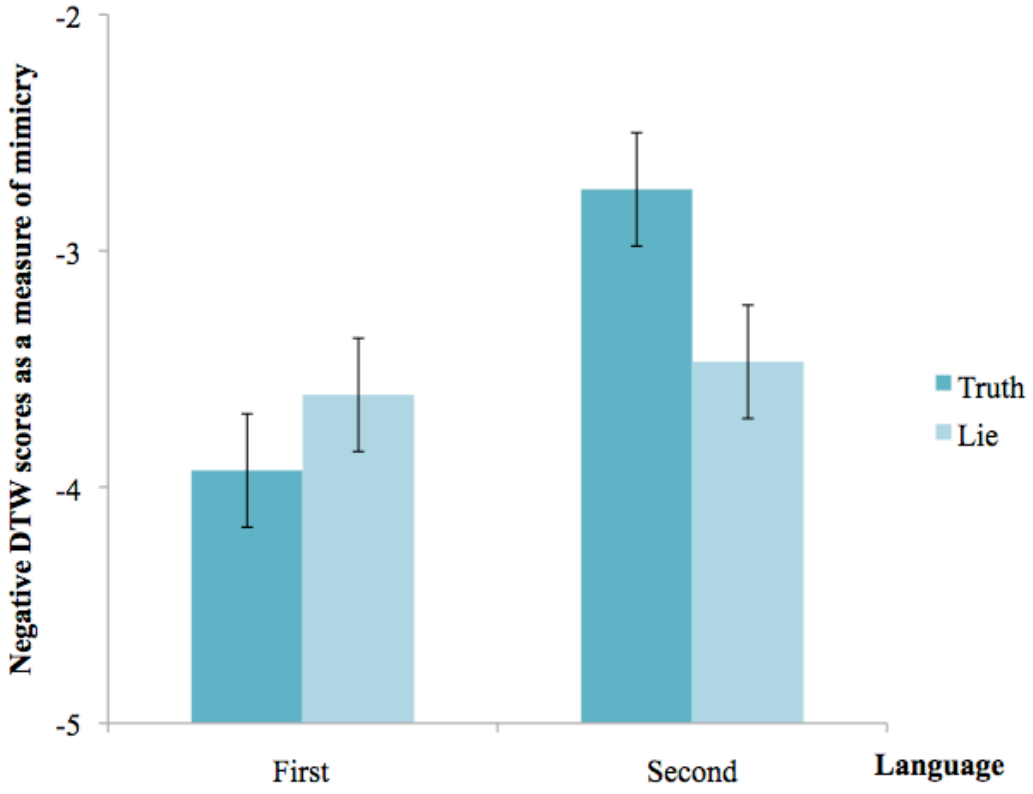

Figure 5.1. Mean negative upper-body DTW values as a function of language and veracity (error bars = SE).

5.5 Discussion

This study sought to investigate the effect of second language on the mimicry differences observed between truth-tellers and liars in earlier Chapters. Those studies revealed that mimicry increased during lying, and that the increase was associated with lie difficulty. One of the ambitions of this study was to determine whether a

cognitive load account, or a foreign language anxiety account of behaviour change was supported by what was observed in interviewees' behaviour. The results favour the cognitive load explanation for mimicry occurrence in two ways. First, it was hypothesized that second language use would also affect nonverbal mimicry due to the cognitive load it places on the speaker (Cheng & Broadhurst, 2005). Consistent with this prediction, more mimicry occurred amongst interviewees speaking in their second language compared to their first language, supporting H1. Importantly, this occurred regardless of the veracity of interviewees' statements, an effect regularly found in culture sensitive deception research (Vrij, 2008). The results suggest that the effect of cognitive load on mimicry is not restricted to load induced by lying, but can be caused by other load inducing factors as well. This result emphasizes the importance of taking compounding factors like second language use into account when attempting to differentiate between truth tellers and liars based on cognitive load induced cues.

Secondly, in particular support of the third Hypothesis, the data showed that the degree of interviewer-interviewee mimicry was determined by an interaction between statement veracity and language. In first language interviews, more mimicry occurred when the interviewee was lying compared to when she or he was telling the truth, providing partial support for H2. By contrast, in the second language interviews, more mimicry occurred when the interviewee was telling the truth compared to when she or he was lying. This finding is consistent with Chapters 3 and 4, since interviewees speaking in their first language mimicked the interviewer more when lying compared to truth telling. However, during second language interviews, more mimicry occurred when the interviewee was telling the truth, compared to lying. Although the decrease in mimicry associated with lying when speaking a second

language was unexpected, it can still be explained as a consequence of cognitive load. Specifically, it could be argued that the relationship between cognitive load and nonverbal mimicry is inverted 'u-shaped', rather than positive, such that mimicry increases with greater cognitive load up to a certain threshold. Once passed this threshold, an interviewee becomes too cognitively taxed to even be able to deliver largely autonomic behaviour.

Alternatively, the second language mimicry results may better be explained by feelings of anxiety related to lying (Ekman, 1989; Ekman, 2001) and speaking in a foreign language (Caldwell-Harris & Aycicegi-Dinn, 2009; Horwitz et al., 1986). Interviewees reported feeling more anxious when lying compared to telling the truth and feeling more anxious when speaking in their second language compared to their first language. Anxiety can affect mimicry both via the direct and indirect route, as described by IDT. Directly, anxiety caused by lying or second language use may have change a liar's nonverbal behaviour by, for example, increasing the use of self-manipulators, nervousness and eye-gaze, and by decreasing the use of speech related gestures (Gregersen, 2005). Such an adaptation would only occur in the interviewee, while the interviewer's behaviour would remain unaffected; the result being a likely mismatch in behaviour and a reduction in mimicry. Indirectly, signs of anxiety shown by the interviewee could change the perception of the interviewer regarding the innocence of the interviewee, with the consequence of mimicry decreasing. However, a correlation analysis revealed that both the perception of the interviewer and correct detection rates are not associated with mimicry. Anxiety was also not significantly correlated with mimicry, but it may explain why more mimicry occurred during truthful compared to deceptive second language accounts. Interviewees reported feeling more anxious when speaking in their second language compared to their first,

and feeling more anxious when lying compared to when telling the truth. Importantly, interviewees felt most anxious when lying in a second language, which could have directly or indirectly decreased mimicry.

Overall, some of the findings of this study were less straightforwardly connected to cognitive load and may be explained in different ways. First, contrary to the findings of Cheng and Broadhurst (2005), interviewees did not report finding speaking in a second language more difficult than speaking in their first language. Although unexpected, this finding is not completely unprecedented with the literature. For example, Da Silva and Leach (2011) found that, while second language interviewees more often pretended to not understand the interviewer, they actually did not find answering the interviewer's questions more difficult than first language interviewees. Combining our findings with those of Da Silva and Leach (2011) provides evidence that speaking in a second language may not always not more cognitively demanding than speaking in a first language.

So why might second language use not always be more cognitively demanding? One possibility is that people's experiences may be impacted by second language use due to its function as a distancing factor, causing one to be more emotionally neutral (Caldwell-Harris & Aycicegi-Dinn, 2009). This might have a particular impact lying on second language users, as lying is associated with several emotions (e.g. guilt, fear and delight; Ekman, 2001). An alternative possibility concerns study-design related effects. For example, in Cheng and Broadhurst's study (2005), Cantonese interviewees found lying in their second language more difficult than lying in their first language. According to the EF English Proficiency Index 2012, China has a low English Proficiency score, while the Netherlands has a very high English Proficiency score. This proficiency difference may have caused our

interviewees to experience less difficulty when speaking in their second language than interviewees in Cheng and Broadhurst's study (2005).

Second, although interviewees found the interview part about the 'Guess who?' game more difficult than the informal conversation, this difficulty difference between tasks was especially large for liars. While such differences in self-reported difficulty were expected based on the cognitive load inducing strategies that enlarge differences between truth tellers and liars (Vrij et al., 2008), these differences did not translate to differences in nonverbal mimicry. Alternatively, self-reported difficulty may not be an accurate representation of cognitive load. This would explain the discrepancies between mimicry occurrence and self-reported difficulty on language use and task. In future research, cognitive load should be measured more objectively to establish if second language use is associated with higher cognitive load.

5.5.1 Perception of the interviewer.

Interestingly, in contrast with Cheng and Broadhurst (2005) and Da Silva and Leach (2011), this study did not find a lie bias when judging second language speakers. On the contrary, interviewers demonstrated a truth bias when judging people who spoke in their second language. Although this finding is the opposite to the lie biases found in previous second language research (Cheng & Broadhurst, 2005; Da Silva & Leach, 2011), finding a truth bias when testing lay people is in line with the large body of first language deception research (Levine, Park, & McCornack, 1999; Zuckerman et al., 1981). Alternatively, our lack of lie bias may have been caused by the choice of participants. Dutch people typically have a very high English proficiency score, which may have caused second language interviews to be more similar to first language interviews than intended. Moreover, our interviewers were participants who were also speaking and listening in their second language, which

may have made it difficult for them to focus on the verbal and nonverbal behaviour of the interviewee.

This perception result raises an important limitation of this study. Because interviewers were also speaking in a second language, their behaviour may also have been effected, and it may have been more difficult than normal to detect deception (Gregersen, 2005). Not only may this have influenced the observed mimicry, but it also makes it impossible to disentangle the individual impact of the interviewer and interviewee's behaviour on detection rates and mimicry. To distinguish between the effect of second language use in the interviewer and interviewee on mimicry, a new experiment would be needed in which the first and second language of both the interviewer and the interviewee are manipulated.

A second limitation of the results is the failure to find a language effect for difficulty (i.e., interviewees did not report finding speaking in a second language more difficult than speaking in a first language). Although interviewees did change their behaviour depending on language use, they did not report any difficulty differences. This lack of language effect in the current study may be caused high English proficiency levels of Dutch people in general, which will be especially applicable to Dutch university students. Previous second language studies have used second language learners (Gregersen, 2005) or Asian participants (Cheng & Broadhurst, 2005), who might have been less familiar with speaking in a second language, creating a higher cognitive load when doing so. However, language did impact mimicry results, indicate that speaking in a first or second language was different enough to elicit an effect, although the cause of this effect may not be cognitive load.

5.6 Conclusion

The findings of this study begin to demonstrate the importance of interpersonal dynamics to the police context, since they imply a number of reasons why second language speakers might be perceived as suspicious when in fact they are acting in good faith. Several effects that were demonstrated in Chapter 3 and 4 to be associated with lying, are now found to be elicited by second language use as well. For example, interviewees reported feeling more anxious and more mimicry occurred during second language interviews compared to first language interviews. Importantly, these effects occurred regardless of veracity. When including veracity, even an opposite pattern was revealed. Mimicry increased when lying during first language interviews, while mimicry in second language interviews reduced when lying compared to truth telling. The current findings have a practical implication because the police increasingly have to interview people in their second language. Besides encountering suspects who speak in their second language, suspects may also differ in their cultural background. Therefore, the next chapter investigates the effect of culture on mimicry.

Chapter Six: **We Copy what we Know: Behavioural Mimicry is Higher for Same-Cultural Interviews Compared to Cross-Cultural Interviews**

6.1 Abstract

The previous Chapter demonstrated that second language use impacted the observed mimicry within interview, raising the broader question of whether or not cultural differences may also impact the relationship between nonverbal mimicry and deceit. This Chapter explores this question through a study that examined the extent to which having a low or high-context cultural background, in both same and cross-cultural interviews, influenced mimicry levels when lying. From the cognitive load perspective, most mimicry was expected during low-context interviews due to its emphasis on facts and consistency. Interviewee participants were asked to tell truths or lies about two prior tasks: The computer game 'Never End' and a missing £5 note. At interview, same-culture pairs of both cultural groups mimicked more than cross-cultural pairs. Results on a depletion scale and cultural check indicated that the occurrence of mimicry during interviews with same-culture individuals was caused by culture-specific communication preferences. In addition, the mimicry results indicate that mimicry decreases when interacting cross-culturally. Surprisingly, all effects occurred regardless of veracity. The findings suggest that both culture-specific communication preferences and interacting cross-culturally impact nonverbal mimicry.

6.2 Introduction

Police forces increasingly operate in an international context, with the consequence that it is more likely that a suspect's and police officer's cultural background significantly differ (Cheng & Broadhurst, 2005). Since police interviews are primarily aimed at searching for the truth, it is important to understand if and how cultural differences influence the two important goals of police interviewing: information gathering and deception detection (Zhou & Lutterbie, 2005). Research has shown that cultural differences influence the interaction between a police interviewer and a suspect, both when it comes to a suspect's responses to different interviewing techniques and detecting deception (Beune et al., 2011; Beune et al., 2009; Bond et al., 1990; Vrij & Winkel, 1991). This cultural influence highlights the importance of culture sensitive research in the forensic psychology domain.

Culture-sensitive nonverbal behaviour studies in interviewing contexts are scarce and so far, no culture-specific differences between truth tellers and liars have been found (Bond & Atoum, 2000; Bond et al., 1990; Sitton & Griffin, 1981; Vrij & Winkel, 1991). For example, Vrij and Winkel (1991) showed that Surinamese participants generally showed more cues to deception (e.g., gaze aversion, speech disturbances and higher tone pitch) than Dutch participants, even when being truthful. The authors explained these differences by way of differences in cultural attitudes. For example, Surinamese people value eye contact as impolite and provoking, whilst Dutch people judge eye contact to be more positive than gaze aversion. In practice, these misinterpretations of behaviour could lead to a guilt bias in cross-cultural police interviews, with concomitant negative consequences for the suspect. This can occur even though there is no evidence that culture impacts behaviour that is specific to lying. The question that remains is: Are there no culture-specific differences between

truth tellers and liars, or have they, due to methodology choices and limitations in previous research, just not been discovered yet? The present study was designed to measure the influence of low- and high-context cultures on interpersonal processes during police interviews.

In line with previous research studying cultural differences within forensic contexts, we focus our analyses on the distinction between low-context and high-context cultures (Beune et al., 2009; Beune, Giebels, & Taylor, 2010, Beune et al., 2011; Vrij & Winkel, 1991). This distinction, originally developed by Hall (1976), is based on the way cultures differ in information processing during interactions. Hall proposes that all cultures prefer a certain type of information processing, with 'low-context processing' and 'high-context processing' as the two ends of this continuum. Although all cultures have both low- and high-context features, cultures can be characterized as being low- or high-context according to the degree to which the human interaction depends on the importance of context (Abriam-Yago, Yoder, & Kataoka-Yahiro, 1999). Low-context cultures rely on more direct communication, focused on the *explicit information* in the message itself, vested in words and meaning (Kakabadse et al., 2001). By contrast, high-context cultures rely on more indirect communication, focused on the *implicit context* of a message to convey meaning (Adair, 2003; Beune et al., 2011). Generally, low-context cultures are predominantly found in Western, individualistic countries like the United Kingdom, the Netherlands, Germany, and the Unites States, whereas high-context cultures are found to be predominant in non-Western, more collectivistic countries like Suriname, Russia, China, and Japan (Adair & Brett, 2004; Beune et al., 2011; Kim, Pan, & Park, 1998).

6.2.1 Culture and Mimicry

Although mimicry is believed to have an evolutionary basis and occurs in all cultures, this does not mean that there is no cultural variation in its occurrence (Lakin et al., 2003). Cultural differences in mimicry are likely to be caused by two different factors: context dependency and cognitive load. High-context cultures rely more on context then low-context cultures do; they draw on physical aspects of communication, on the time and situation in which the communication takes place, and the relationship between the two individuals interacting (Würtz, 2005). This by extension makes the communication of high-context cultures more dependent on nonverbal strategies, such as gestures, body language, silence, proximity and symbolic behaviour, since these help to convey meanings and messages (Würtz, 2005). Additionally, high-context individuals are not only likely to mimic more than low-context individuals because they tend to rely more on the use of nonverbal strategies, they are also more attuned to the nonverbal behaviour of others. An important characteristic of high-context individuals is that they have more interdependent self-construals than low-context individuals (Markus & Kitayama, 1991; Adair & Brett, 2004). Having an interdependent self-construal is likely to increase one's tendency to mimic, as Chartrand and Bargh (1999) found that individuals who are more perceptually attuned to the behaviour of others, and who place more emphasis on interdependence, mimic more during interaction than individuals who do not have this communal orientation. The assumption that high-context individuals display more behavioural mimicry was experimentally tested in a study conducted by Van Baaren et al. (2003b), in which Japanese (high-context, interdependent) and US (low-context, independent) participants discussed photos with a confederate who was rubbing their face whilst interacting. Results confirmed that in

same-culture dyads, high-context individuals mimicked face rubbing more than low-context individuals in an information conversation setting.

The second culture-related factor that might influence mimicry relates to cognitive load. The basis of low-context communication is the quality maxim (i.e. facts) and the principle of consistency. The 'quality maxim' relates to the fact that, in low-context communication, one should state only that which is believed to be true on the basis of sufficient evidence (Beune et al., 2009; Grice, 1975), since these communicators rely on logic (e.g., if-then constructions) and rationality (Adair & Brett, 2004). This preference for rationality is also the basis of the consistency principle, which states that low-context individuals consider a lack of consistency to make a statement less plausible and hence, less truthful (Beune et al., 2009; Beune et al., 2011; Choi & Nisbett, 2000; Cialdini, Wosinska, Barrett, Butner, & Gornik-Durose, 1999). Evidence for the importance of consistency in low-context communication was provided Cialdini et al. (1999), who's experiment demonstrated that consistency arguments were more effective in influencing people from low-context cultures than from high-context cultures when it came to responding to a request to participate in a market survey. Arguably, communication preferences in which consistent and fact-based arguments are more effective, are likely to be more cognitively demanding than communication preferences that do not rely on those principles. If communicating in general is more cognitively demanding for low-context individuals compared to high-context individuals, and there is a positive relationship between cognitive load and mimicry, low-context individuals are likely to mimic more when communicating than high-context individuals.

The two cultural factors predicted to impact mimicry raise hypotheses that differ in their direction: the emphasis on context and interdependence within high-

context cultures will lead to more mimicry within high-context interviews; the emphasis of cognitive load suggests that the additional demands of adhering to the quality maxim will lead to more mimicry within low-context interviews. From the existing literature it is not clear which factor will have a stronger impact on resulting behaviour, but the previous Chapters suggest that mimicry will at least be affected by cognitive load. Therefore, more nonverbal mimicry is expected to occur during interviews with low-context individuals, compared to high-context individuals (H1).

Of interest is not only the question how culture affects mimicry during truthful interactions, as it becomes particularly interesting when the communication involves lying. Communication preferences of low- and high context cultures are hypothesized to cause mimicry effects in opposing directions, which are caused by different factors (i.e., relying on nonverbal strategies and increased cognitive load). Due to differences in the nature of both factors, lying is likely to have a different effect on mimicry depending on cultural background. For high-context individuals, veracity should not have a substantial influence on mimicry levels because they rely heavily on the nonverbal aspects of communication in general. For low-context individuals however, lying should further increase cognitive load, leading to higher mimicry levels compared to when being truthful. Arising from this, we expect an interaction effect (H2), whereby the mimicry difference between truth telling and lying is particularly visible in low-context interviews.

So far, the impact of culture-sensitive communication preferences on mimicry has been discussed under the assumption of shared communication preferences by both interlocutors. However, due to a substantial increase in the cultural diversity of people encountered by the police, the effect of communicating across cultures has become increasingly relevant (Giebels & Taylor, 2009). When judging the

truthfulness of a statement, people's cultural distinctive communication patterns form a baseline for the detection of deception. In cross-cultural interactions, the communication patterns of both interlocutors may not overlap, causing people to judge their interaction partner from their own frame of reference, rather taking a culture-sensitive approach (Taylor et al., 2013). When familiarity with the baseline of behaviour is lacking, it increases the difficulty of detecting lies from that unfamiliar culture. For example, Bond et al. (1990) found that both Americans and Jordanians had more difficulty detecting lies told by people from the other culture, compared to lies told by people from their own culture.

An explanation for people's lack of ability to judge deception cross-culturally is provided by the expectancy violation model by Bond et al. (1992). This model proposes that people tend to judge unexpected behaviour that diverges from their own culture-sensitive norms as deceptive. In their study, Bond et al. (1992) found that, regardless of veracity, observers perceived actors who performed unexpected behaviours (e.g., head tilting and staring) as more dishonest than those who did not behave in such way. This finding has implications for cross-cultural interactions, seen as research has demonstrated that culture impacts an individual's nonverbal behaviour (Matsumoto, 2006), such as gestures (Ekman, 1976), touching (Remland, Jones, & Brinkman, 1995) and interpersonal space (Hall, 1963). For example, while eye contact is interpreted positively in Dutch culture, in Surinamese culture this behaviour is seen as provoking (Vrij & Winkel, 1991). According to the expectancy violation model, this mismatch in cultural norms and consequently the violation of the interviewer's expectancies when looking away can cause the interviewer to be increasingly suspicious. Evidence for this model was provided by Vrij and Winkel (1994), who videotaped Dutch and Surinam actors displaying typical Dutch or

Surinam behaviour on a video. Both Surinamese and Dutch actors were judged by Dutch police officers as more suspicious when they showed nonverbal behaviour consistent with Surinamese cultural norms compared to when showing typical Dutch behaviour. The expectancy violations mentioned so far are based on nonverbal behaviours. However, the model is applicable to verbal behaviour as well. Whilst low-context individuals value consistency very highly, this is less important in the communication of high-context individuals (Adair & Brett, 2004, Beune et al., 2009; Beune et al., 2011). This leads to the tendency of low-context individuals to judge consecutive consistent statements as being truthful, but inconsistent statements as being deceptive (Granhag & Strömwall, 2000). During cross-cultural interactions, these different communication preferences may cause a violation of expectancies in the interviewer.

The violation of expectations is likely to impact nonverbal mimicry, both on a direct and indirect level. Directly, unfamiliarity with an interaction partner's baseline behaviour may cause difficulties when attempting to copy that person's behaviour. When interacting, people are expected to adapt their usual intra-cultural behaviours to the culture-specific behaviours of their interaction partner (Adler & Graham, 1989). However, during cross-cultural interactions, people may have more difficulty recognizing and interpreting the behaviour of their interaction partner (Bond et al., 1990; Vrij et al., 2010), which can arguably reduce the occurrence of mimicry. Indirectly, increased suspicion in the interviewer caused by a violation of their expectancies may further reduce the occurrence of mimicry. Therefore, we expect lower mimicry levels in cross-culture interviews compared to same-culture interviews (H3).

6.3 Method

6.3.1 Participants.

One hundred-and-eighty male and female participants from Lancaster University (Mean Age = 22.43 yrs, Range 18-64) participated in pairs as either 'interviewee' or 'interviewer'. Half of the interviewers and interviewees came from a low-context cultural background (i.e., British, n = 90), while the remaining half came from a high-context cultural background (i.e., a variety of South Asian countries, n = 90). Consistent with previous research (Beune et al., 2011; Giebels & Taylor, 2009), participants were classified as low- or high-context based on their self-declared country of birth.

In this study, both same-cultural and cross-cultural pairs were tested. The same-cultural pairs existed of a British interviewer and interviewee (30 pairs), or a South Asian interviewer and interviewee (30 pairs). In the cross-cultural interviews (30 pairs), the interviewer was always British and the interviewee was always South Asian. This aspect of the design was driven by the fact that studying the nature of low-context interviewers and high-context suspects is more relevant for law enforcement practice in the UK (i.e., dominantly low-context country). The experiment lasted 70 minutes in total and all participants received £7.5 for their time.

6.3.2 Materials

The post-interview questionnaire comprised a cultural check and a depletion scale, and, for the interviewer, questions about judging the truthfulness of the interviewee's statements.

6.3.2.1 Cultural check.

The cultural check was administered to check whether participants who were put in the low or high-context condition based on country of birth, also belonged to

that category based on their preference for low- or high context communication. In line with Beune et al. (2011), a 22-item scale was derived from a 71-item scale originally developed by Adair, Buchan and Chen (2009). This scale included 16 items that sought to measure approaches to guessing meaning (3 items), humbleness in communication (8 items) and truth bending (5 items), and 6 items that measured assertive persuasion and multitasking, because of their relevance to deception. For example, the scale included items that measure indirect communication (e.g., "I am able to recognize others' subtle and indirect messages"), sensitivity for maintaining social harmony (e.g., "I often bend the truth if the truth would hurt someone") and humbleness in communication ("I am modest when I communicate with others). The internal consistency of this measure with the current data was below the desired level of $\alpha \geq .70$ (22 items; $\alpha = .65$). As a consequence, one item was excluded from the questionnaire ('I listen very carefully to people when they talk'), raising the alpha to .71, with the final scale consisting of 21 items scored on a Likert scale from 1-7.

6.3.2.2 State Ego Depletion.

According to the ego depletion theory, people have limited cognitive resources, which are necessary to engage in self-regulation activities and executive control processes (Baumeister & Vohs 2007). When engaging in those activities, cognitive resources get depleted, which will affect performance on subsequent tasks if they require similar cognitive resources. For example, Schmeichel, Vohs and Baumeister (2003) have demonstrated that depletion negatively affects more complex tasks, while leaving more simple tasks unaffected. Depletion is of interest in deception research because both lying and attempting to detect deceit can require more cognitive resources than engaging in truthful conversations (DePaulo et al., 2003; Kassin & Gudjonsson, 2004; Reinhard, Scharmach & Stahlberg, in press; Vrij

et al., 2010). The State Ego Depletion Scale was used to measure depletion experienced by the interviewee (Janssen, Fennis, Pruyn, & Vohs, 2008) and is used as an indication of cognitive load. The scale consists of 25 items, including 'Right now, it would take a lot of effort for me to concentrate on something', 'I can't absorb any more information', and 'I feel sharp and focused' (reversed item). After converting the reversed items, both depletion test 1 (25 items on a Likert scale from 1-7; Total score range 25-175; $\alpha = .93$) and depletion test 2 (25 items; $\alpha = .94$) were found to be highly reliable.

6.3.2.3 Interviewer post-interview questions.

Interviewers were asked to indicate whether or not they thought the interviewee was speaking the truth about both tasks. They were also asked to indicate their confidence in this judgement, using a scale ranging from ‘not at all certain’ (1) to ‘absolutely certain’ (7).

6.3.3 Procedure.

The experiment comprised a pre-interview stage in which the interviewee completed two tasks, and an interview stage in which the interviewer asked the interviewee questions about the pre-interview tasks. Half of the interviewees were required to respond truthfully to the questions of the interviewer, and half were required to lie.

6.3.3.1 Pre-interview.

Interviewees arrived at the lab and received instructions about the pre-interview tasks. The first task consisted of playing a computer game called ‘Never End’ for seven minutes. In the truth condition, interviewees actually played the game and they were asked to truthfully respond to the questions of the interviewer about the game during the interview. In the lie condition, interviewees received a form with

information about the ‘Never End’ game, but they were not allowed to play the game. Instead, they had to use the provided information to fabricate a story of how they would have played this game and they were asked to convince the interviewer during the interview they really played the game.

Before the experimenter left the room to meet and instruct the interviewer, she set a timer at 3 minutes and left a set of covered instructions on the desk. The interviewee was instructed to open these instructions for the second task when the timer went off. The second assignment involved bringing a wallet with a £5 note in it to a lost-property box at the end of the corridor. Interviewees in the truth condition were asked to bring the wallet to the lost-property box and return to their game when this task had been achieved. In the lie condition, interviewees were asked to remove the £5 note from the wallet and hide it somewhere on their body, before returning to their original assignment of fabricating a story of how they would have played the ‘Never End’ game. They were asked to deny during the interview they had removed any money from the wallet, but instead explain that they brought the wallet to the lost-property box. The stolen money scenario was chosen to increase the stakes of the lie. Stealing money is a criminal offense and may include a stigmatisation of the person whole stole the money when caught. In general, all interviewees were told that if they managed to convince the interviewer that they played the ‘Never End’ game and that they brought the wallet to the lost-property box untouched, then they would be entered into a prize draw for £50. This incentive was given to further increase the stakes and to ensure that the suspect would be sufficiently motivated and involved regarding the assignment. Upon completion of the pre-interview tasks, the experimenter checked if the interviewee performed the instructions correctly, by checking if the wallet was located in the lost and found box in the truth condition, or

asking if they hid the £5 note somewhere at their body in the lie condition. All participants managed to follow the instructions correctly.

Whilst the interviewee was engaged in the pre-interview tasks, the experiment went to the second lab, where she instructed the interviewer about their task. The interviewer was told she or he was going to ask the interviewee questions about two topics, a game of 'Never End' and a missing £5 note. During the interview, she or he would ask the interviewee a pre-made set of questions about both topics, and would have to decide if the interviewee was being truthful or not. The questions about the game of 'Never End' involved interviewees to recall the event in reverse order, to increase cognitive load levels, especially for liars (Vrij et al., 2008). These questions were: (1) Please tell me how your game ended; (2) At what level did your game end?; (3) What was your total score?; (4) How was the score calculated?; (5) For what item did you get the most points?; (6)What happened when you went through an exit?; (7) How many times did your character die?; (8) How did your character usually die?; (9) Please tell me about the lay-out of the game: any specific colours, effects or sounds?; (10) Please tell me about the commands; (11) What is the main aim of this game?; (12) Please tell me how your game started; and, (13) Please tell me how you felt when playing the game. The questions about the missing £5 note were asked in forward order, and the questions were: (1) Did you take the £5 while you were here playing 'Never End'?; (2) Please explain what you were doing while you were in this room from start to finish. Include all details please; (3) So this means you went out of the room?; (4) How long was the walk to the room where the lost property box was located?; (5) Did you see anyone in the hallway while you were walking to the lost property box?; (6) If so, how did he/she look like?; (7) When you arrived in the room, how many items were in the lost property box?; (8) Could you describe these items

for me please?; (9) What was written on the box?; (10) What was next to the box? (11) Describe the room the lost property box was in; (12) Where did you put the wallet in the box, in relation to the other items?; (13) How long were you gone from this room?; (14) How do you feel about this money gone missing?; and, (15) Lastly, I will ask you again: did you take the £5?

The interviewers were then told they would be asked to fill in their judgment on a questionnaire after the interview, and were told that in the case of correct detection of deception, their name would be put in a £50 prize draw.

6.3.3.2 Interview.

After the interviewee finished the pre-interview tasks, the experimenter removed all evidence of the tasks and invited the interviewer into the room. The experimenter then helped both participants put on the Xsens MVN full-body motion suits (see Chapter 2) and sat participants on chairs facing each other. Unlike the previous Chapter, it was decided to not put a table in between the participants, so that full-body behavioural mimicry would become relevant (i.e., a table did not obtrude viewing the lower half of the body). Once set up, the experimenter gave the interviewer the first set of questions about the 'Never End' game. The experimenter then retreated to a corner of the lab to monitor the Xsens MVN data. After 2.5 minutes, the experimenter stopped the interview about the first topic and handed the interviewer the second set of questions about the missing £5 note. This part of the interaction also ran for 2.5 minutes, after which time both participants to fill in the post-interview questionnaire. Interviews were cut off after 2.5 minutes to keep the length of the interaction consistent.

6.3.4 Measuring nonverbal mimicry.

During the interview, nonverbal mimicry was measured using two full-body Xsens MVN motion capture systems, in line with previous research presented in Chapter 5 and with the use of the method described in Chapter 2. Because participants were able to view the entire body of their interaction partner, a full-body measure of nonverbal mimicry was used as the Dependent Variable.

6.4 Results

The post-interview questionnaire measures provided the opportunity to check the culture manipulation and investigate how participants experienced the interview.

6.4.1 Culture.

To check whether or not the classification of participants based on their country of birth translated into a difference in culture-specific communication preferences, the scores on the cultural check measure were compared across the low- and high-context groups. An independent-samples *t*-test of Cultural background on Culture check score revealed that participants who were classified as high-context indeed scored higher on this scale ($M = 5.09$, $SD = .56$) than participants classified as low-context ($M = 4.89$, $SD = .50$), $t(178) = 2.48$, $p = .014$. Participants did not only differ in their cultural background, but differed in native language use as well. An independent-samples *t*-test of Cultural background on Native language revealed that participants who were classified as high-context much more often spoke in their second language during the interview (96%) than participants classified as low-context (0%), $t(178) = 43.74$, $p < .001$.

6.4.2 Cognitive load.

To measure if cultural background and veracity affected how depleted interviewees felt after the interview, an ANOVA was performed with the Cultural

background of both participants (i.e., Low-context, high-context and Mixed) and Veracity as the independent variables, and interviewees' scores on the Cultural check as the dependent variable. The depletion scale results revealed that interviewees in low-context (M = 81.77, SD = 26.09) interviews found the interview more depleting than high-context interviewees, regardless of whether the high-context interviewees were interviewed by high-context (M = 58.60, SD = 18.13), or low-context (M = 65.57, SD = 25.53) interviewers, $F(2, 84) = 7.42$, MSE = 571.651, $p = .001$, $\eta^2 = .15$. Neither a main effect for Veracity, $F(1, 84) = .13$, MSE = 571.651, $p = .715$, $\eta^2 = .00$, nor an interaction between Culture and Veracity was found, $F(2, 84) = .08$, MSE = 571.651, $p = .926$, $\eta^2 = .00$.

6.4.3 Detection rates.

As part of the interviewer post-interview questionnaire, interviewers had to judge the truthfulness of the interviewee's statements about both topics. Two chi-square analyses of Veracity (between subjects variable) on Detection rates for both the game 'Never end' and the Stolen money were performed to calculate the associations between detection rates and veracity. The test for the Game 'Never end' revealed a significant association between detection rates and veracity, $X^2(1) = 16.06$, $p < .001$, $\Phi = .42$. Interviewers were better at judging truths (correct detection rate 66%) than detecting lies (24%). The test for the stolen money did not reveal a significant association between detection rates and veracity, $X^2(1) = .23$, $p = .631$, $\Phi = .05$. Another set of two chi-square analyses tested the effect of Culture (Between subjects variable) on Detection rates for both the game 'Never end' and the Stolen money. The test for the Game 'Never end' did not reveal a significant association between detection rates and culture, $X^2(2) = 3.87$, $p = .144$, Cramer's V = .21.

Similarly, the test for the stolen money did not reveal a significant association between detection rates and culture either, X^2 (2) = .66, p = .721, Cramer's V = .09. Cramer's V was used as a measure of effect size instead of Phi because there were three cultural groups (i.e., Low-context, High-Context and Mixed; > 1 df). Last, a chi-square analysis of Task (within subjects variable; McNemar Chi Square test was performed) on General Detection rates was performed to calculate the associations between detection rates and task. The test revealed there was no significant association between detection rates and task, p = .644. In conclusion, only when discussing the game 'Never end' were detection rates affected by veracity, with truths being detected correctly more often than lies.

6.4.4 Nonverbal mimicry.

To test the hypotheses, negative DTW scores were examined as a function of veracity and culture. Figure 6.1 shows interviewer-interviewee mimicry in terms of negative DTW scores as a function of veracity and culture.

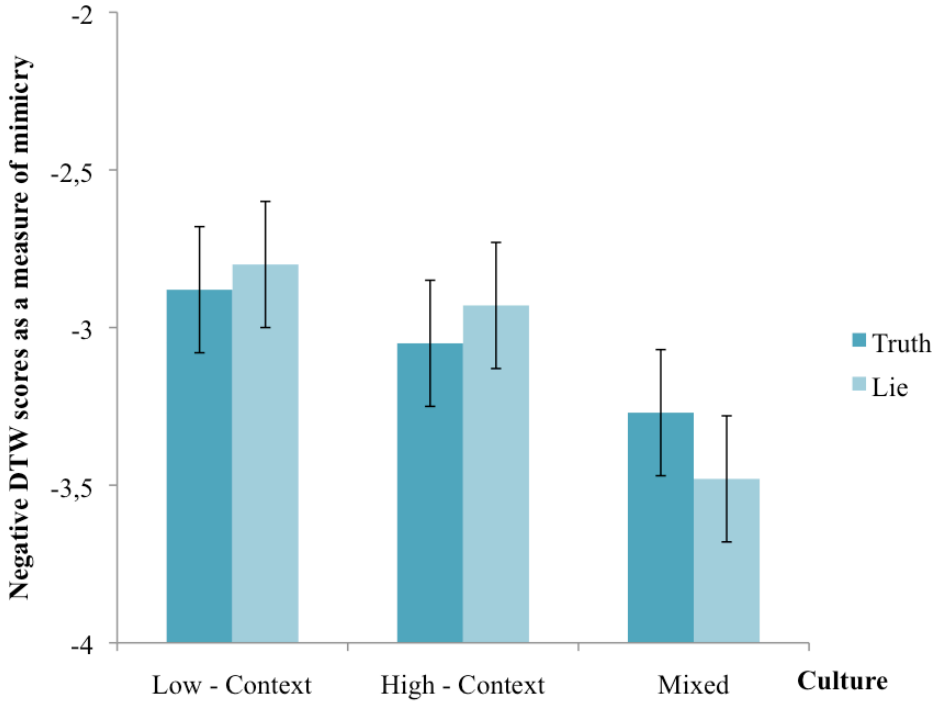

Figure 6.1. Mean negative full-body DTW values as a function of culture and veracity (error bars = SE).

A 2 (Task) x 2 (Veracity) x 3 (Culture) mixed ANOVA in which task was the repeated measure, and veracity and culture were between-subject measures, revealed neither a main effect for veracity, $F(1, 84) = .11$, MSE = 1.21, $p = .743$, $\eta^2 = .00$ nor a mimicry difference between low- and high-context same-culture pairs ($p = .460$). However, LSD post-hoc testing revealed that in line with H3, a main effect for culture was found, $F(2, 84) = 5.22$, MSE = 1.21, $p = .007$, $\eta^2 = .11$, with mixed pairs mimicking each other less ($M = -3.46$, $SD = .87$) than both the low-context ($M = -2.84$, $SD = .66$; $p = .003$) and high-context same-culture pairs ($M = -2.99$, $SD = .74$, $p = .021$).

An additional main effect for type of task was found, with pairs mimicking each other more when talking about the game 'Never End' ($M = -3.04$, $SD = .83$), compared to when talking about the missing £5 note ($M = -3.15$, $SD = .81$), $F(1, 84) = 12.63$, MSE, .04, $p = .001$, $\eta^2 = .12$. Both main effects were subsumed by a task by culture interaction, $F(2, 84) = 3.20$, MSE, .04, $p = .046$, $\eta^2 = .06$, with high-context pairs mimicking a similar amount regardless of task, (game 'Never End' $M = -2.98$, $SD = .77$; missing £5 note $M = 2.99$, $SD = .71$), whilst mixed pairs (game 'Never End' $M = -3.40$, $SD = .93$; missing £5 note $M = 3.51$, $SD = .89$) and low-context pairs (game 'Never End' $M = -2.73$, $SD = .62$; missing £5 note $M = -2.94$, $SD = .70$) mimicked more when talking about the game compared to the missing £5 note.

6.5 Discussion

In a globalized world, where people with different nationalities and cultural backgrounds are committing and fighting crime across borders (Cheng & Broadhurst,

2005; Kakabadse et al., 2001; Zhou & Lutterbie, 2005), law enforcement personnel encounter suspects from different cultural backgrounds. These backgrounds are likely to bring with them different 'interaction rules' (Adair & Brett, 2004; Hall, 1976; Würtz, 2005), which may impact the suspect's behaviour and increase the difficulty of correctly detecting deception. It is therefore important to combine the fields of cross-cultural research and research on deception to establish which behaviours are more general and culture-specific and which behaviours are specifically caused by lying. In response to this issue, this study examined the impact that cultural differences may have on the natural nonverbal mimicry that occurs in interpersonal interaction.

The first hypothesis was designed to investigate the influence of culture on mimicry in same-culture interviews (Lakin et al., 2003), focusing particularly on whether behaviour is more influenced by high-context cultures reliance on nonverbal communication (Adair & Brett, 2004; Beune et al., 2011) or by the cognitive demands of the quality maxim (Adair & Brett, 2004; Beune et al., 2009). The results on the depletion measure showed that low-context participants were more depleted after the interview than high-context participants, regardless of them telling truths or lies. Interestingly, low-context individuals found the interview harder than high-context individuals, although the majority of high-context participants were speaking in their second language rather than their first. This ego depletion finding lends tentative support to the cognitive load explanation. Further support for the cognitive load hypothesis was provided by the elicitation of more mimicry by the interview topic that was recalled in reverse order (i.e., the game 'Never End'), compared to the topic recalled in forward order (i.e., the missing £5 note). Recalling an event in reverse order has been demonstrated to increase cognitive load and magnify differences between truth tellers and liars (Vrij et al., 2008). Interestingly, this effect occurred

especially when interacting with a low-context interviewer, rather than a high-context interviewer. Arguably, in order to convince the interviewer of their innocence, interviewees may have tried to adapt to the communication preferences of the interviewer. The emphasis on quality maxim and consistent arguments in low-context communication (Adair & Brett, 2004; Beune et al., 2009) could have consequently increased cognitive load in all interviewees that were interviewed by low-context interviewers.

However, the anticipated behavioural consequence of low-context interviewees feeling more depleted after the interview, namely, that these pairs would show more mimicry, was not observed. There was no difference in mimicry observed between low and high-context pairs. Instead, as was predicted in the third hypothesis based on the expectancy violation model (Bond et al., 1992), more mimicry occurred when the interviewer and interviewee were from the same culture compared to when they were from different cultures. This effect occurred regardless of veracity. Interestingly, this result does not only allow for concluding that people mimic less in general when interacting cross-culturally, but it also leaves room for the first hypothesis. It was hypothesized that both low- and high-context communication characteristics could increase mimicry, although the effects arguably have different underlying causes. Based on previous Chapters, a dominant impact of cognitive load was predicted. For the low-context pairs, the degree of mimicry was high both when telling the truth and when lying because low-context individuals were highly depleted regardless of their veracity condition. For the high-context pairs, mimicry was higher presumably because of these interactants' cultural preference for interdependence and relying on context when communicating. Support for the latter assumption was provided by the results on the cultural scale, by showing that high-context

interviewees had more high-context communication preferences (i.e., they relied more on context and the nonverbal aspects of communication) than low-context interviewees. Both low- and high-context same-culture pairs mimicked more than cross-culture pairs, suggesting that both cognitive load and context-dependent communication may have increased mimicry in interviews with same-culture individuals.

Contrary to what was expected based on previous Chapters, all mimicry findings occurred regardless of veracity, leading to a rejection of the second hypothesis. This lack of veracity effect may be explained by a similar lack of veracity effect for the depletion scale. In contrast to our prediction, and in contrast to Chapters 3 and 4, liars did not report feeling more depleted by the interview than truth-tellers, suggesting that lying may not have been more cognitively demanding than truth telling. The lack of cognitive load difference between truth tellers and liars significantly limits what can be said about the subsequent possible effect of load on within and across culture mimicry. The most parsimonious explanation for the lack of cognitive load effect between truth tellers and liars is that the lies were too easy. Specifically, participants received an instruction form with information about how to play the 'Never End' game, which included an explanation of the rules, the objective of the game and an elaborate description of different aspects and layout of the game. The depletion scale results suggest we might have provided participants with too much information, making it too easy to lie. Similarly, the nature of both the 'Never End' game and the money taking tasks might have influenced the lack of experienced depletion when lying because both playing a computer game and bringing an object to a lost-property box are relatively common activities. Participants might have been able to draw on previous experiences when fabricating and telling the lie, reducing

cognitive load. DePaulo et al. (2003) found that lies based on scripts or familiar stories are "unlikely to be marked by the signs of mental effort" because a liar who sticks to a script or familiar story may be less likely to get tangled in contradictions than a liar who makes up a completely new story

Alternatively, lies may have been more cognitively demanding than truths, but the State Ego Depletion scale may not be an accurate representation of cognitive load. To investigate this possibility, cognitive load in the next Chapter will be measured by both a self-report difficulty question and the Ego State Depletion scale.

6.6 Conclusion

This study has contributed new perspectives on the low-context versus high-context communication field and debate. Results suggest that low-context individuals were more depleted when communicating in general, indicating that they rely on more cognitive strategies when communicating. Results from the cultural check revealed that high-context individuals relied more on nonverbal strategies and were more context-dependent than low-context individuals. Arguably, these culture-specific communication characteristics led to high mimicry levels in general during both low- and high-context same-culture interviews. In addition, more mimicry occurred when people interacted with someone from the same culture, compared to cross-culture interactions. All mimicry effects occurred regardless of veracity, indicating that lying was not more difficult than truth telling. Evidence for this perspective was provided by a lack of veracity effect on the depletion scale, showing that interviewees were not more depleted when lying compared to truth telling. Although the current findings suggest an impact of culture on nonverbal, the lack of veracity effect limits the conclusions that can be drawn from this study. In the next Chapter, lie difficulty is increased to investigate the cause of the lack of mimicry differences between truth

tellers and liars. To this end, low- and high-context interviewees were asked to perform two new, more difficult tasks and were subsequently interviewed in an information-gathering or accusatory interview style. These interview styles do not only differ in the amount of cognitive load they elicit, but also in the use of accusations. Both the social nature of mimicry and its correlation with cognitive load make studying the effect of interview style on mimicry interesting.

Chapter Seven: **Interview Style Impacts Nonverbal Mimicry depending on Cultural Background**

7.1 Abstract

So far, all studies in this thesis on interpersonal processes between interviewer and suspect have solely investigated information-gathering interviews. However, interview style may impact nonverbal mimicry from both a social and cognitive perspective. To test which perspective is more influential, we examined the impact of information-gathering and accusatory interviews on the occurrence of nonverbal mimicry. British and South Asian participants performed one out of two art related tasks; a visit to an art exhibition on campus or a virtual tour through the Louvre museum. During the interview, interviewees pretended they completed both tasks. As a result, each interview consisted of a truth and a lie. Results of an analysis of upper-body nonverbal mimicry measured using Xsens MVN suits indicated that interviewees respond differently to interview styles depending on cultural background. British interviewees mimicked more when interviewed in an information-gathering style compared to an accusatory style, while South Asian interviewees showed the opposite pattern of behaviour. These findings highlight the importance of taking culture into account when examining the effects and effectiveness of interview styles.

7.2 Introduction

The field of deception research is currently going in a new direction, in which the focus has shifted from solely examining a liar's behaviour to a more active role of the interviewer and the strategies she or he can use to detect deception (Vrij & Granhag, 2012; Vrij et al., 2007). This focus on interviewer behaviour and how that can affect interviewee behaviour has a natural fit with the nonverbal mimicry focus of this thesis. If interactants mutually affect each other's mimicry, then how an interviewer behaves will affect the responses of the interviewee. A good example of the impact an interviewer has is the responses that are elicited when different questions styles are used. When Moston and Engelberg (1993) systematically analysed a set of real police interviews, they found that interviews could broadly be divided into two categories, more information-gathering style interviews and more accusatory style interviews. Interviewing style is likely to affect an interviewer's behaviour and subsequently the interviewee's behaviour because the styles differ substantially in their rationale and method.

The rationale behind accusatory interviewing techniques is to increase compliance and the likelihood of a confession (Gudjonsson, 2003; Williamson, 1993). This can be done by inducing anxiety, fear and guilt in suspects through the use of accusation, manipulation and confrontation (Inbau et al., 2001; Meissner et al., 2012). An accusatory interview often includes one or more direct confrontations regarding the allegedly committed offence, such as, "did you commit the crime?". Manipulation can for example be accomplished by minimizing the crime, achieved through statements such as "I would probably have done the same if it was me in that situation". Although these tactics have proven successful in eliciting confessions, the accusatory approach has also been associated with high levels of false confessions

(Kassin et al., 2010; Kassin & Gudjonsson, 2004; Meissner, Russano, & Narchet, 2010). By contrast, the primary aim of information-gathering techniques is to search for the truth (Baldwin, 1993; Bull, Valentine, & Williamson, 2009). This can be done through the use of open questions that encourage suspects to provide a detailed account of events. Rapport-building and active listening are key ingredients of a successful information-gathering interview (Hartwig et al., 2005; Meissner et al., 2012; Milne & Bull, 2001; Williamson, 1993). The more ethical information-gathering interviews haven proven to reduce false confession rates whilst still eliciting true confessions (Gudjonsson, 2003; Meissner et al., 2012; Williamson, 1993). Additionally, the information-gathering interview style has a positive impact on the length of response and amount of details suspects provide, which is beneficial when attempting to detect deception (Fisher, Brennan, & McCauley, 2002; Vrij et al., 2007).

Although there are police interview manuals that advice interviewers to pay attention to nonverbal behaviour (Inbau et al., 2001), how interview style actually impacts on verbal (Colwell, Hiscock & Memon, 2002; Hernandez-Fernaud & Alonso-Quecuty, 1997; Vrij et al., 2007) and especially nonverbal behaviour is not well known (Vrij, 2006; Vrij et al., 2006a). One exception to this is Vrij (2006). When interviewed in an accusatory style, Vrij's (2006) interviewees showed less gaze aversion and made fewer movements, such as illustrators, foot and leg movement, compared to when being interviewed in an information-gathering style. This behaviour occurred regardless of veracity. These results provide evidence that interviewees show different behaviours under different interview styles and that this effect may overshadow behaviour caused by lying. This Chapter develops this

research by taking a culture-sensitive approach to investigating the effect of interview style on nonverbal mimicry.

7.2.1 Interviewing Style and Culture.

As identified in the previous Chapter, there are a number of reasons to believe that individuals from low and high-context cultures will respond differently to the various interviewing styles. Although some interviewing strategies, like being kind, do not elicit different responses depending on cultural background, some do (Beune et al., 2010). For example, low-context individuals have been found to respond well to rational arguments that are often used in information-gathering interviews (Beune et al., 2010). This finding can be explained through the preference of low-context individuals for direct and explicit communication (i.e., quality maxim; Kakabadse et al., 2001). They tend to find the content of a message important, with consistency and fact-based statements as core ingredients. On the contrary, threatening someone's context has proved more effective when negotiating with high-context individuals, rather than low-context individuals. This can be explained through the more indirect, implicit, and relationship-and context-orientation of high-context communication (Adair & Brett, 2004; Beune et al., 2011). High-context cultures have a more collectivistic attitude, in which social bonds are of high importance. These studies provide evidence that culture determines how people respond to different aspects of interviewing styles, for example by eliciting more information. How culture will affect interview-specific nonverbal mimicry is discussed below.

7.2.2 The effect of interview style and culture on mimicry.

The importance of taking interview style into account when examining interpersonal processes of deception was highlighted in a study by Dunbar et al. (2011). They found that regardless of veracity, pairs mimicked most during informal

background questioning, followed by suspicion questioning and interviewees mimicked least when directly accused. Interestingly, a mimicry difference between truth tellers and liars was only found during the direct accusation part of the interview, with liars mimicking more than truth tellers. This finding is important because, so far, all studies of this thesis have been performed in an information-gathering interview style. Both mimicry's association with cognitive load and its social aspect (i.e., its relationship with rapport, empathy and liking; Chartrand & Bargh, 1999; Chartrand & Van Baaren, 2009; Lakin & Chartrand, 2003; Lakin et al., 2003) could cause mimicry to differ between information-gathering and accusatory interviews. From a cognitive perspective, although there is a general belief that information-gathering interviews are easier to undergo than accusatory interviews, experimental research suggests the opposite and found the detailed accounts provided after open questions being more cognitively demanding than short denials (Vrij et al., 2007). Information-gathering interviews being more cognitively demanding than accusatory interviews is likely to increase interactional mimicry because mimicry increases under greater cognitive load. From a more social perspective, being interviewed in accusatory style will create several negative feelings through the use of accusation, manipulation and confrontation (Inbau et al., 2001; Meissner et al., 2012), such as an increased discomfort and feeling judged to be guilty (Vrij et al., 2006b). On the contrary, information-gathering interviews were more associated with positive feelings in interviewees, such as the feeling they were listened to by the interviewer (Vrij et al., 2006b). These feelings, elicited by interview style, could impact mimicry, seen as the relationship between liking and mimicry is bi-directional (i.e., people who like each other, mimic more, and people who mimic each other, will like each other more; Lakin et al., 2003). Due to the both more cognitively demanding and

cooperative nature of information-gathering interviewing techniques, it is hypothesised that more mimicry will occur in information-gathering interviews compared to accusatory interviews (H1).

The previous Chapter described how culture-related communication preferences impact nonverbal mimicry both in a cognitive and a social way. From a cognitive perspective, the low-context communicator's emphasis on rationality and the use of facts and arguments based on sufficient evidence (Beune et al., 2009; Beune et al., 2011; Cialdini et al., 1999) made low-context communication more cognitive demanding than high-context communication. From a social perspective, the high-context communicator's emphasis on nonverbal strategies and interdependence (Würtz, 2005), made high-context communicators more perceptually attuned to others. Both perspectives led to a high mimicry occurrence in interviews with low- and high-context pairs. Although both low- and high-context individuals mimicked to a high degree when interacting with someone from their own culture, the degree of mimicry was much lower when interacting cross-culturally.

The effect of interviewing style on mimicry can interact with culture in different ways. From a cognitive perspective, most mimicry is expected to occur in information-gathering interviews with low-context individuals; low-context communication is more cognitively demanding than high-context communication due to its emphasis on facts and consistency (Beune et al., 2009) and information-gathering interviews are more cognitively demanding than accusatory interviews because they trigger longer and more detailed answers (Vrij et al., 2007). From a social perspective, most mimicry is expected to occur in information-gathering interviews with high-context individuals; high-context communication put high emphasis on interdependence and the use of nonverbal strategies (Würtz, 2005) and

both have been found to increase interactional mimicry (Chartrand & Bargh, 1999). In general, the use of accusatory strategies like confrontation, accusation and manipulation (Dunbar et al., 2011; Inbau et al., 2001; Meissner et al., 2012) are likely to decrease cooperation and subsequently mimicry, while more cooperative information-gathering interviews are likely increase mimicry levels. Due to the context- and relational-sensitive communication preferences of high-context individuals, the effect of interviewing technique on interpersonal processes may be magnified. Evidence that high-context individuals do not respond well to accusatory techniques was provided by Giebels and Taylor (2009), who found that the use of threats was less effective when communicating with high-context individuals compared to low-context individuals. These cognitive and social perspectives lead to competing hypotheses. Based on the previous Chapters, a dominant influence of cognitive load on mimicry is expected, with most mimicry occurring in information-gathering interviews with low-context individuals (H2).

7.3 Methods

7.3.1 Participants.

One hundred and eighteen people took part in this study at Lancaster University (Age M = 23.25 yrs, Range 16 – 51, Males = 58), and acted as both the interviewee and interviewer. Interviewees (n = 59) participated for approximately 75 minutes in return for payment of £8. Interviewers (n = 59) participated for approximately 45 minutes in return for £5. Participants were classified as having a low- or high-context cultural background based on their self-declared country of birth (Beune et al., 2011; Giebels & Taylor, 2009).

7.3.2 Materials.

7.3.2.1 Information-gathering and accusatory questions.

Interviewers were provided an interview protocol that comprised of either 17 information-gathering style or 21 accusatory style questions. These questions were adapted from those used in Vrij et al. (2006b). According to Blair (2005), an accusatory style interview would not start with an accusation of lying but with a set of questions aimed at gaining information. Only after this phase, and in cases where guilt is assumed, an accusatory interrogation will begin (Inbau et al., 2001). To take this division into account as much as possible, both interview styles started with the same three general, open-ended questions (e.g., "Can you tell me, into as much detail as possible, what happened when you were doing the virtual tour?/visited the art exhibition in the library", "Can you please describe to me, into as much detail as possible, what you saw during the virtual tour/your visit to the art exhibition", and "please tell me everything you have learned about the Louvre/library on campus today, that you did not know before). These were then followed by a set of either information-gathering or accusatory questions about the virtual tour through the Louvre museum and the visit to an art exhibition on campus (see Appendix A for an overview of all interviewer questions). Examples of information-gathering questions are: i) Please tell me where you were when doing the virtual, ii) How did you try to find out the answers to the questions?, and iii) Can you tell me as much as possible about the answers you found? Examples of accusatory questions are: i) Did you actually do the virtual tour?, ii) Tell me what you did to find out the answers to the questions, and iii) If you actually had done the virtual tour, wouldn't you have been able to answer the questions better?

7.3.2.2 Post-interview questionnaire.

The post-interview questionnaire comprised 16 questions about general information, 8 questions about the participants' emotions, 22 questions that comprised a cultural check, and 25 questions that comprised a state ego depletion scale.

The 16 general question sought information about personal details (i.e., gender, age, country of birth, native language), previous experiences that may compound with the task (i.e., "have you ever visited the art exhibition or Louvre before?", and "Did you know the other participant?"), questions about the tasks they completed (i.e., "did you do the Virtual Tour?", and "did you visit the art exhibition?") and a question on a scale from 'not at all' (1) to 'very much' (7) about their understanding of the experiment (i.e., "how well did you understand the assignment?").

The 8 emotion questions required participants to indicate their agreement to a series of statement using a 'not at all' (1) to 'very much' (7) Likert scale. For the interviewee participant, eight statements, four about each task, asked about the extent to which they agreed that: i) the task was difficult; ii) that they felt anxious; iii) that they felt nervous; and, iv) that they felt happy.

The State Ego Depletion Scale was used to measure depletion in both interviewers and interviewees (Janssen et al., 2008). The scale consists of 25 items on a Likert scale from 'not at all' (1) to 'very much' (7) including "Right now, it would take a lot of effort for me to concentrate on something", "I can't absorb any more information", and "I feel sharp and focused" (reverse-scored item; see Chapter 6 for a more detailed description). After converting the reversed items, the reliability of this scale proved high, both for interviewees at time one, administered after describing the

first task (α = .93), and for interviewers and interviewees at time two, administered after completing the interview (α = .95).

In line with the Chapter 6, a cultural check was administered to determine whether participants self-declared country of birth assignments to the low-context and high-context conditions also belonged to that category according to their communication preferences. See Chapter 6 for a more detailed description of the scale. The reliability of this scale for the current participants was below the desired level of α ≥ .70 (22 items on a Likert scale from 1-7; Total score range 21-147; α = .67). A leave-on-out analysis found that removing one item was not sufficient to improve the scale reliability significantly (Range α .63 - .68), which led to the decision to keep all 22 items. Although the 22-item version of this culture check was not optimally reliable, a trade-off between length of the experiment and scale reliability had to be made.

Additionally, interviewers were asked to indicate binomially for each topic if they thought the person was being truthful or not. Their confidence regarding the veracity judgments was measured on a Likert scale from 'not at all' (1) to 'very much' (7).

7.3.3 Procedure.

Participants were arranged to attend the lab in pairs, either as same-culture pairs (*n* = 31; i.e., comprising two British participants) or cross-culture pairs (*n* = 28; i.e., comprising one British and one South Asian participant). In the cross-culture pairs, the interviewer role was always performed by a British participant[1] and the

[1] One of the interviewers in this condition was from Ireland. The results from the culture check revealed that the Irish participant's score was within two standard deviations of the low-context mean score on the measure. It was therefore decided to keep data of the Irish participant in the sample.

interviewee role was always performed by a South Asian participant. This division of roles was based on its relevance for Western (i.e., mostly low-context cultures) law enforcement practice.

The experiment comprised two stages: A pre-interview stage during which the interviewee completed one task and imagined a second task, and an interview stage in which the interviewer questioned the interviewee about those tasks.

7.3.3.1 Pre-Interview.

Interviewees were instructed to complete one of two tasks. Half completed a computer-based virtual tour through the Louvre museum, while the other half visited an art exhibition in the Library on campus. All interviewees received task instructions on how to complete their task both verbally and on paper. They also received an information sheet that instructed them on how to start their task, provided them with general task-related details, and included three questions that they were required to answer whilst completing the task. The questions were designed both to engage the participant with the tasks, and to check whether or not participants actually performed the tasks.

The virtual tour took place in the experimental room. It involved opening the laptop and spending 15 minutes virtually walking through the Egyptian antiquities section of the Louvre museum in Paris (the virtual tour can be accessed through http://www.louvre.fr/en/visites-en-ligne). By using the mouse, interviewees could enter new rooms and zoom in on specific artefacts. Engaging in these actions was necessary to answer the three questions on the information sheet. Visiting the art exhibition in the Library on campus required participants to leave the experimental room to go to the Library and look at the displayed art. In both cases, the experimenter checked the answers to the questions to make sure interviewees actually

visited the exhibition. These two art-related tasks were chosen because the tasks involved participants telling a truth and a lie about events rich in different types of details, such as transport (e.g., walking to the library, moving around in a digital space), content (please describe certain painting/objects) and opinion (what was your favourite painting/object). Lies in real life can be complex, and the design of this study tried to capture this complexity to resemble real life as much as possible in a lab setting.

On completion of the task, participants were instructed that, although there were two art-related tasks, they were only to perform one. They were then given an information sheet about the second task and were told that if they managed to convince the interviewer that they performed both tasks their name would be put in a prize draw for a food and drink prize. The interviewee was then left alone to fabricate a story about completing the second task. After 10 minutes the experimenter returned and asked the interviewee to fill in the first State Ego Depletion Scale to measure how cognitively taxing performing the tasks had been.

7.3.3.2 Interview.

Before the interviewer entered the experimental room, the experimenter reminded the interviewee to respond truthfully to the questions about the performed task, and to tell a plausible fabrication about the imagined task. The experimenter then went to collect the interviewer and would explain to him/her: “There is a participant in this room who has been there for a while. You are going to ask him/her questions about two topics: A virtual tour through the Louvre museum and visiting an art exhibition in the Library on campus. I will give you the lists of questions that I want you to ask. Please do not ask any extra questions, just read the questions on the sheet out loud. After you have asked all questions about both topics, I want you to decide if

you think the participant was telling the truth or not. You will be asked to provide this information and additional details on a post-interview questionnaire." The interviewer then introduced both participants, explained the procedure of the interview and helped both participants put on the Xsens MVN full-body motion suits (see Chapter 2).

Once set up, the experimenter provided the interviewer with the set of questions about the first task. Both topic and veracity were counterbalanced; half of the pairs started discussing the virtual tour whilst the other half started with the art exhibition visit. Half started with the truth and half started with the lie. Interview style was manipulated as a between-subjects variable. Half of the interviewers received a set of questions based on information-gathering interviewing techniques, and half received a set of questions based on accusatory techniques (see Materials for a description of the questions, and see Appendix A for a full list).

After handing the first set of questions to the interviewer, the experimenter retreated to the corner of the room to monitor the Xsens MVN data. Once all questions about the first topic were asked, the experimenter provided the interviewer with the second set of questions. When all questions were asked, the experimenter handed both participants the post-interview questionnaire. For interviewees, this questionnaire included the second State Ego Depletion Scale. This scale was administered twice to interviewees, in order to distinguish between load caused by performing the pre-interview tasks and by the interview. The depletion scale got administered once to interviewers (i.e., as part of the post-interview questionnaire). On completion, the experimenter helped participants remove the suits, and proceeded to debrief both participants.

7.3.4 Measuring nonverbal mimicry.

Participants were sitting at a table during the interview. Therefore, only upper-body data were used to calculate mimicry scores, using the procedure outlined in Chapter 2. Two pairs of participants were excluded from the analysis because their negative DTW scores exceeded three times the standard deviation of the other participants. Most likely these outliers were caused by incorrect use of the equipment. Although the Velcro bands fit most body shapes, sometimes the sensors had to be taped to the body because the Velcro bands were not large enough, which may have unintentional sensor movement during the interview. This left 57 pairs in the analysis.

7.4 Results

7.4.1 Manipulation checks.

The post-interview questionnaire administered to both participants provided the opportunity to both collect personal information and measure how people were affected by the interview.

7.4.1.1 Culture.

To check whether participants who were classified as high-context individuals based on their country of birth actually scored higher on the culture scale than low-context participants, an independent-samples *t*-test was conducted with Cultural background as the independent variable and Culture check score as the dependent variable. The test revealed that the initial division of interviewees based on country of birth and upbringing did not effectively separate low- (i.e., British; $M = 107.02$, $SD = 10.50$), and high-context cultures (i.e., South Asian; $M = 104.44$, $SD = 13.13$), $t(1) = 1.05$, $p = .297$. A possible explanation for this lack of culture effect is the low scale reliability described in the methods section.

7.4.1.2 State Ego Depletion.

The interviewee's responses on both Ego State Depletion questionnaires were submitted to a 2 (Time) x 2 (Culture) x 2 (Interview style) mixed ANOVA with time as the repeated measure. In general, low-context interviewees (i.e., British; M = 85.22, SD = 25.03) felt more depleted than high-context interviewees (i.e., South Asian; M = 66.59, SD = 19.78), $F(1, 53) = 12.00$, MSE = 850.75, $p = .001$, $\eta^2 = .18$. A second general effect was found: Interviewees felt more depleted after the interview (M = 79.12, SD = 25.84) than before the interview (M = 73.67, SD = 23.07), $F(1, 53)$ = 4.23, MSE = 185.81, $p = .045$, $\eta^2 = .07$. This effect was accompanied by an interaction effect of Time and Interview style, $F(1, 53) = 4.93$, MSE = 185.81, p = .031, $\eta^2 = .08$. Although participants were randomly appointed to an interview style condition, the interaction effect seemed to be caused by differences in depletion across interview styles before the interview, rather than after the interview. Before the interview, interviewees in the accusatory interview condition felt more depleted (M = 78.26, SD = 22.90) than interviewees in the information-gathering interview condition (M = 69.53, SD = 22.81). After the interview, interviewees in the information-gathering interview condition felt more depleted (M = 80.27, SD = 25.73) than interviewees in the accusatory interview condition (M = 77.85, SD = 26.38). However, two independent samples t-tests showed that the before mentioned differences in depletion between the two interviewing techniques both before, $t(55)$ = -1.44, $p = .156$, and after the interview, $t(55) = .35$, $p = .728$, were not significant.

In conclusion, whilst there was no depletion difference caused by the interview for interviewees who were interviewed in an accusatory style, interviewees in the information-gathering did report feeling significantly more depleted after the

interview compared to before the interview. This finding is in line with previous research by Vrij et al. (2007) who found that information-gathering interviews are more cognitively demanding than accusatory interviews.

7.4.1.3 Perceived difficulty.

The self-report difficulty question was submitted to a 2 (Veracity) x 2 (Culture) x 2 (Interview style) mixed ANOVA with Veracity as the repeated measure. Regardless of interview protocol, all interviewees found lying (M = 4.42, SD = 1.71) more difficult than truth telling (M = 2.37, SD = 1.33) , $F(1, 53) = 47.89$, MSE = 2.43, $p < .001$, $\eta^2 = .47$. Also, British interviewees found the interview in general more difficult (M = 3.83, SD = 1.45), than South Asian interviewees (M = 2.91, SD = 1.45), $F(1, 53) = 12.93$, MSE = 1.94, $p = .001$, $\eta^2 = .19$. Surprisingly, there was no main effect of Interview style, $F(1, 53) = .20$, MSE = 1.94, $p = .653$, $\eta^2 = .00$, and no interaction between Culture and Interview style, $F(1, 53) = 1.29$, MSE = 1.94, $p = .261$, $\eta^2 = .02$, a finding that is not in line with this study's ego depletion results.

7.4.1.4 Veracity judgements.

A McNemar test was performed to test the association between veracity and detection rates. Although interviewers were more accurate when detecting truths (72% correct) than they were when detecting lies (47% correct), this effect was not significant, $p = .235$. This effect may be explained by a truth bias, seen as interviewers demonstrated a tendency to judge interviewees' accounts more often to be truthful (62% judged as truthful), than deceptive (38% judged as deceptive; $t(113) = 8.27$, $p < .01$). Two chi-square analyses were performed to test the association between Detection rates and Interviewing technique, and Detection rates and Culture,

and results showed that both Interview technique, $X^2(1) = .09$, $p = .763$, $\Phi = .03$, and Culture $X^2(1) = 1.14$, $p = .286$, $\Phi = .10$, were not associated with detection rates.

7.4.2 Mimicry.

To test the hypotheses relating to the effect of Culture and Interview style on nonverbal mimicry, we examined upper-body mimicry scores as a function of Veracity, Culture and Interview style. Figure 7.1 shows upper-body negative DTW scores as a function of Culture and Interview style. A 2 (Veracity) x 2 (Culture) x 2 (Interview style) mixed ANOVA with Veracity as a repeated measure revealed an interaction effect of Culture and Interview style on nonverbal mimicry, $F(1, 53) = 6.24$, MSE = .40, $p = .016$, $\eta^2 = .11$. Most mimicry occurred in information-gathering interviews with low-context interviewees ($M = -1.29$, $SD = .29$), followed accusatory interviews with high-context interviewees ($M = -1.44$, $SD = .46$), to accusatory interviews with low-context interviewees ($M = -1.64$, $SD = .57$), and information-gathering interviews with high-context interviewees ($M = -1.68$, $SD = .49$). Neither a three-way interaction between Veracity, Culture and Interview styles, $F(1, 53) = .28$, MSE = 1.29, $p = .600$, $\eta^2 = .01$, nor main effects on mimicry for Veracity, $F(1, 53) = .02$, MSE = 1.29, $p = .891$, $\eta^2 = .00$, Culture, $F(1, 53) = .65$, MSE = .40, $p = .426$, $\eta^2 = .01$, or Interview style, $F(1, 53) = .22$, MSE = .40, $p = .639$, $\eta^2 = .00$, were found. Because the first three questions of both interview styles were similar, an additional analysis was computed in which the data of the first two minutes of each interview were removed. On average, interviewees took two minutes to answer these first three questions. Removing this data allowed for a cleaner analysis of the effect of interview style on mimicry. Results of this adjusted data set analysis were similar to the analysis of the entire data set. The only significant result was the interaction effect between

Culture and Interview technique on upper-body mimicry, $F(1, 53) = 6.74$, MSE = .41, $p = .012$, $\eta^2 = .11$.

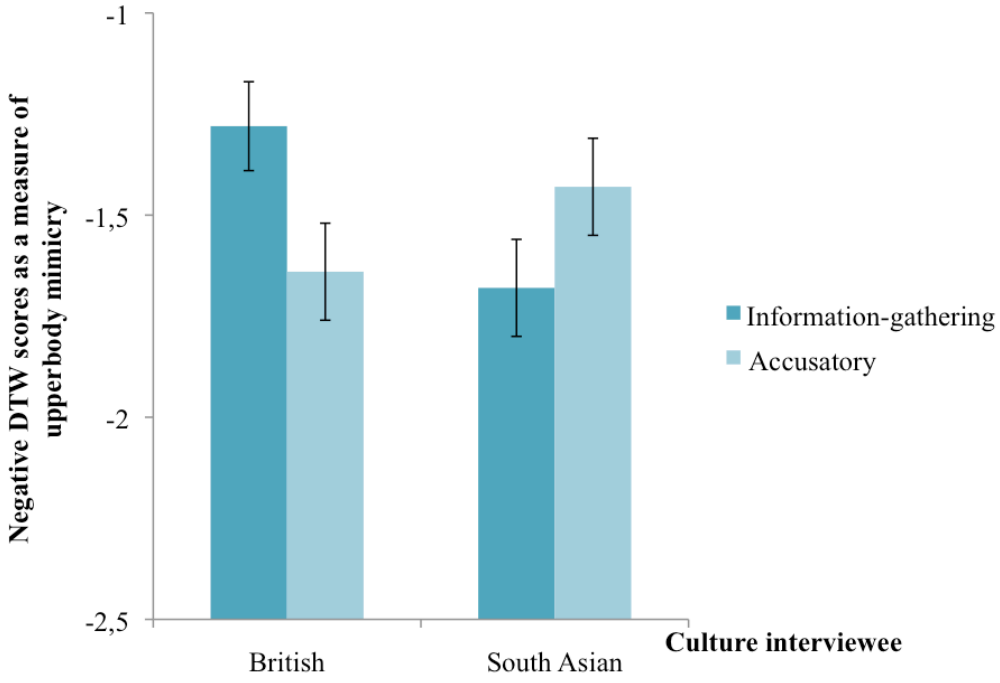

Figure 7.1. Mean negative full-body DTW values as a function of culture and interview style (error bars = SE).

7.5 Discussion

The aim of the current study was to disentangle the effect of interview style and culture on interpersonal processes during interviews when people tell truths and lies. This is of importance because police officers regularly have to interview and subsequently attempt to detect deceit in people from different nationalities and cultural backgrounds (Cheng & Broadhurst, 2005; Zhou & Lutterbie, 2005). Cultural background is likely to impact communication style and 'interaction rules' (Adair & Brett, 2004; Hall, 1978; Würtz, 2005), which may affect the responses of suspects to the general style and more specific techniques used by interviewers. How it does so,

however, remains an open question, and this study sought to test two possible perspectives on why interactional mimicry would be affected.

The analyses revealed that interview style by itself did not impact nonverbal mimicry, leading to a rejection of the first hypothesis. However, this lack of main effect of interview style on mimicry was caused by a difference in response based on cultural background. British (i.e., low-context) interviewees mimicked more during information-gathering interviews than during accusatory interviews, whilst the opposite was true for South Asian (i.e., high-context) interviewees. The result that most mimicry occurred in information-gathering interviews between two low-context individuals is best explained from the cognitive perspective, where automatic processes gain importance when cognitively taxed (Hofmann et al., 2007; Van Leeuwen et al., 2009). This finding was hypothesized (H2) because both low-context communication and information gathering interviews can be more cognitively demanding than high-context communication and accusatory interviews, consequently leading to higher mimicry levels.

The cognitive perspective explains these findings best in two ways. First, communicating can be more cognitively demanding for people from low-context cultures because of its fact-based, rational and consistent nature (Adair & Brett, 2004; Beune et al., 2009). Evidence for this hypothesis was provided by both measures of cognitive load. British interviewees (i.e., a low-context culture) both felt more depleted and found the interview more difficult than South Asian Interviewees (i.e., a high-context culture). However, because the current design only manipulated the cultural background of the interviewee, we cannot determine whether the effects on mimicry were caused by differences between low- and high-context communication preferences, or by communicating across cultures. However, the condition with the

second highest degree of mimicry was a cross-cultural condition, suggesting that cross-cultural interactions did not substantially disrupt mimicry and the effect is more likely to be caused by culture-sensitive communication preferences.

Second, more mimicry was expected to occur in information-gathering interviews compared to accusatory interviews (H1), because the details required to answer open questions is arguably more cognitively demanding than the short denials elicited during accusatory interviews (Vrij et al., 2007). The mimicry results partly support Hypothesis 1, as most mimicry occurred in a condition involving information-gathering interviews, and the depletion scale results suggest that information-gathering interviews increased depletion more than accusatory interviews did. However, no effect of interview style on self-reported difficulty was found. One possible explanation for the absence of reported difficulty differences between interview styles is that the effect of cultural background and veracity on load overshadowed the influence of interview style. When investigating several cognitive load inducing factors, some factors that induce relatively little load may be subsumed by other, more influential factors.

An alternative explanation is that the information-gathering and accusatory style interviews in this study did not differ enough in cognitive load to create an effect. If so, this was most likely not caused by the questions we used, as they were based on questions used in Vrij et al. (2006b), who did find an interview style effect. Rather, the difference is likely to reside with the fact that we used participants as interviewers who did not receive instructions on how to behave whilst asking the questions. This decision was made in order to avoid polluting the natural occurrence of mimicry by repetition and learning effects, but it may have decreased feelings of discomfort due to interview styles, which subsequently led to the lack of effect. This

explanation, however, does not sit well against the evident interaction effect found between culture and interview style, nor against the depletion scale results, since these findings suggest that the two interview styles differed enough to affect mimicry.

Not all findings in the current study support the cognitive load approach. The first example is the finding that in interviews with high-context interviewees, more mimicry occurred when interviewed in an accusatory style, compared to an information-gathering style. This effect can neither be explained by the cognitive perspective, nor by the social perspective. In both perspectives, high-context individuals should mimic more during information-gathering interviews than during accusatory interviews. Also when consulting the culture-sensitive literature on negotiating and interviewing, this result was surprising because intimidating behaviour (Fu & Yukl, 2000) and the use of threats (Giebels & Taylor, 2009) have been found to be less effective when communicating with high-context individuals compared to low-context individuals. However, in their study, Dunbar et al. (2011) demonstrated that liars mimicked more than truth tellers, but only during the accusatory part of the interview. Their explanation was that deceivers might try to restore their credibility and rapport with the interviewer by increasing their mimicking behaviour when being met with suspicion, as was the case during the accusatory part of the interview. This explanation may be applicable to the current study as well. Hypothetically, high-context individuals being more interdependent and attuned to others could have the consequence that they are more motivated to restore their rapport with the interviewer than low-context individuals. Rapport is more likely to be disrupted during accusatory interviews than during information-gathering interviews, providing an explaining why a high degree of mimicry occurred during accusatory interviews with high-context interviewees.

The second and most important example is the lack of a difference in nonverbal mimicry across veracity. In line with the existing literature (Cheng & Broadhurst, 2005; Vrij et al., 2010), the self-report difficulty question indicated that interviewees found lying harder than telling a truth. However, contrary to what was expected, veracity did not affect mimicry levels. The absence of a general veracity effect on mimicry may be explained by it being overshadowed by the impact of cultural background and interview style on mimicry. Not finding a veracity effect when conducting culture-sensitive mimicry studies is not uncommon (Vrij, 2008). In Chapter 6 I did not find a veracity effect either, but that lack of veracity effect was accompanied by a lack of difference in participants' self-reported cognitive load. In other words, participants in that study did not find lying more cognitively demanding than truth telling, which could explain why people telling truths and lies did not differ in their mimicry use. However, this rationale is not applicable in the current study where self-report difficulty did differ.

The explanation for the lack of veracity effect might have to come more from a language perspective, rather than, or in addition to, a cultural perspective. Whilst all low-context participants had English as their first language, this was true for only 11% of the participants from high-context cultures. Second language use has been found to increase cognitive load (Cheng & Broadhurst, 2005) and activate a lie bias (Cheng & Broadhurst, 2005; Da Silva & Leach, 2011), and both factors have the potential to affect mimicry. In Chapter 5 it was found that people mimicked more in first language interviews when lying, but less in a second language interview. If language use can affect mimicry in two directions and participants in this study differed in their native language, this may have polluted the expected but not found veracity effect.

When designing the interview protocol, we tried to imitate practice as close as possible. For that reason, both interviews started with three open questions, before continuing with more information-gathering or accusatory questions. However, this interview design still does not match actual accusatory interviews, since accusatory interviews are only followed up by an interrogation when guilt is suspected (Inbau et al., 2001). Although not completely ecological valid, the choice for the current design in which all interviews started with a free recall period, did allow for a more natural introduction to the use of accusatory question then would have been the case without such a period. Interesting follow-up research would be having all interviewees be interviewed in an information-gathering style, and subsequently let the interviewer decide if they want to follow up with an accusatory interview or not. This would resemble practice even better than the currently used design.

The use of participants as interviewers will have had a higher impact on mimicry outcomes in this study compared to previous chapters because of the accusatory interview condition. Interviewers only received instructions to read the questions out loud and were not instructed to behave in a certain way. This decision was made to not pollute the natural occurrence of mimicry, but will have had the accompanying effect that accusatory interviews in our study were less threatening compared to studies in which trained interviewers were used. That interview style affected mimicry proves that the styles were different enough to elicit a response. However, it would be interesting to investigate if the same interview style effect on mimicry would occur during more realistic accusatory interviews.

7.6 Conclusion

In the current study we demonstrated the importance of taking culture into account when examining the effectiveness of different interview styles. Cultural

background determined in which way interpersonal processes were affected by interview style, with British (i.e., low-context) interviewees mimicking most during information-gathering interviews, whilst finding the opposite effect for interviews with South-Asian (i.e., high-context) interviewees. This finding can best be explained by cognitive load differences between low- and high-context cultures and their culture-sensitive preference regarding interaction rules. However, although liars found the interview more difficult and they were more depleted than truth tellers, the nonverbal mimicry increase associated with lying and lie difficulty found in previous research was not replicated in the current study. This Chapter confirms the effect of cognitive load on interactional mimicry and highlights cultural differences in interviewee's response to different interview styles.

Chapter Eight: **General Discussion**

Identifying the differences between truthful and deceptive behaviour is a central aspect of forensic research settings. A substantial body of evidence from studies of nonverbal behaviour during deception suggest that, while there are some behavioural differences between truth tellers and liars, no behaviour is uniquely related to deceit. Those behaviours that are related to deceit are usually only weakly correlated and have small effect sizes (DePaulo et al., 2003; Vrij et al., 2010). However, most of this research on discovering nonverbal cues to deception has solely focused on behavioural changes in the liar, ignoring the interactional aspect of lying (Buller & Burgoon, 1996). The aim of this thesis was to explore if and how lying impacts interpersonal processes (Chapters 3 and 4) and which forensically relevant, external factors moderate this process (Chapters 5, 6, and 7). The thesis achieved this using a novel, automatic method of measuring nonverbal mimicry, which was objective and precise compared to the traditional use of manually coding videos (Chapter 2). This final Chapter is used to discuss the findings of the previous Chapters in the light of the deception and nonverbal mimicry literature. Subsequently, the implications of this research for investigators is discussed, and recommendations for future research are presented.

8.1 Measuring Nonverbal Mimicry

In psychological research, human nonverbal behaviour has traditionally been measured through manually coding videos with the use of classification schemes (Lausberg & Sloetjes, 2009). Chapter 2 outlined a method of using motion capture technology to measure nonverbal mimicry. The inspiration to start measuring behaviour automatically rather than manually originated from an increasing awareness of reliability issues with manual coding (Scherer & Ekman, 1982) and was

further assisted by technological developments and active use of these developments in computing research (Altorfer et al., 2000; Bente et al., 2008). The AMAB method allowed for an objective and inclusive analysis of full-body movement, with greater detail than was possible with manual coding (Poppe et al., in press). For example, AMAB made it possible to take the direction and magnitude of all movement into account, including small movements and postural shifts that are difficult to code manually.

The currently used automatic analysis of nonverbal mimicry measures the similarity in movement between two interactants, which according to the definition of mimicry can be interpreted as nonverbal mimicry. Nonverbal mimicry is defined as the automatic tendency to imitate the behaviours of other people, including postures and gestures (Chartrand & Bargh, 1999; Stel et al., 2009). A current problem in mimicry research is that mimicry is not properly defined. For example, researchers use different maximum delays for copied behaviours to still be counted as mimicry (e.g., 3-5 seconds, 7 seconds, 10 seconds). Also, the methodology used to measure mimicry impacts the outcome. So far in psychological research, mimicry is often defined through coding or ratings. When ratings are used, participants are usually asked to watch (a video of) an interaction and indicate on a Likert scale how much mimicry occurred. This indication of mimicry is very subjective, and especially when rating several interactions in a row, a rating becomes a relative judgment, rather than an absolute, objective measure of mimicry. In the case of coding, multiple coders are instructed to count how often a specified set of behaviours occur for each individual interactant, and subsequently it is counted how many of those behaviours are copied by the other interactant within a specified amount of seconds, for example 10 seconds (Stel et al., 2009). A total mimicry measure is then created by dividing the mimicked

amount of movements by the total amount of movements (Stel et al., 2009). When coding mimicry, clear movements will determine the mimicry score. When rating mimicry, in addition to matched movements, the atmosphere of the interaction and similarities between baseline poses and postures will impact mimicry score as well.

As well as manual coding affects the mimicry outcome, the same applies to automatic coding. When automatically coding mimicry with the use of AMAB and DTW, similarity in pose is used as the basis for a measure of mimicry. In practice this means that, in line with mimicry ratings, baseline poses impact mimicry as well as movements. Automatic analysis of mimicry differs from ratings regarding the subjective element, meaning that atmosphere or general impression does not impact mimicry scores. In addition, the automatic analysis of mimicry differs from the manual analysis regarding their level of detail, with automatic coding providing a much more detailed imagine of mimicry than manual coding. Although automatically coding mimicry has several benefits, one should keep in mind the differences in mimicry definition it implies. Beneficially, this more detailed information about the occurrence of mimicry can be used to help defining what mimicry exactly is and is not. The effect measurement methods have on the definition and occurrence of mimicry will need to be established in future work to increase the validity of mimicry. In practice this might mean that different method-specific terminology will need to be used for the different definitions of mimicry.

8.2 The Effect of Lying on Nonverbal Mimicry

In general, the degree to which people mimic depends on the social and cognitive aspects of the situation. From a social perspective, people mimic more when they like the interaction or their interaction partner, and this relationship between liking and mimicry is bi-directional (Lakin et al., 2003). Since lying and being lied to

are mostly associated with negative feelings (Ekman, 1989; Ekman, 2001), this social explanation of nonverbal mimicry expects that lying would cause people to mimic less. From a cognitive perspective, people have been found to mimic more when they are under greater cognitive load, which is caused by mimicry's automatic aspect (Hofmann et al., 2007; Van Leeuwen et al., 2009). Thus, if the cognitive explanation is most dominant, lying would cause people to mimic more.

These conflicting hypotheses were first examined in Chapter 3, describing a study in which interviewee participants told a truth and lies of increasing difficulty. The results demonstrated that people mimic more when fabricating a lie compared to when telling a truth and concealing information. Interestingly, mimicry occurrence was correlated with self-reported difficulty, a measure used to capture cognitive load. Subsequently, Chapter 4 replicated the mimicry effect and demonstrated that the effect of load on mimicry was not explained away by manipulation of a liar's attention. In other words, mimicry does not seem to increase when lying compared to truth telling due to increased monitoring of the receiver, a phenomenon associated with lying described by Buller and Burgoon (1996) and Schweitzer et al. (2002). Rather, the findings of both experiments confirm that more mimicry occurs during deceitful interviews compared to truthful interviews and that this effect was caused by an increase in cognitive load when fabricating lies.

This finding builds on the existing literature on automatic processes gaining importance when cognitive loaded (Hofmann et al., 2007). Although the positive relationship between cognitive load and nonverbal mimicry was already discovered by Van Leeuwen et al. (2009), they only studied the copying of finger movement. Our study extends existing knowledge by showing that the same principle of increased mimicry under greater cognitive load is also applicable to the more complex

interactional mimicry, measuring full- and upper-body movement rather than one isolated limb. From a forensic angle, there already is a body of literature showing that lying is more cognitively demanding than truth telling (DePaulo et al., 2003; Kassin & Gudjonsson, 2004; Vrij et al., 2010) and deception researchers are currently exploring how to increase cognitive load in interview settings to magnify differences between truth tellers and liars (Vrij et al., 2008; Vrij et al., 2009). When combining this cognitive load literature with the current finding that interactional nonverbal mimicry increases with greater cognitive load, it leads to an interesting possibility to distinguish between truth tellers and liars.

Chapters 3 and 4 also highlights the importance of lie type and lie characteristics when conducting deception research. Although fabrications in forward and reverse order were both more difficult and elicited more mimicry than truths, this was not the case when only concealing information. Contrary to what we expected, concealments were not consistently considered more difficult than truths, and consequently, did not increase mimicry occurrence. Based on this knowledge, all following experiments described in this thesis included at least a truth and fabrication lie. Additionally, the studies described in Chapter 3 and 4 were both within-subjects designs and all participants told the truth about the informal conversation, concealed information about the puzzle task and fabricated an account about the Cluedo game. The subject and nature of a conversation can affect the type and amount of movements made. For example, when giving directions, people gesture very differently compared to when they are just having a chat about the weather. Also, people's nonverbal behaviour will be very different when congratulating someone compared to when comforting someone. Similarly, describing an informal chat may elicit very different behaviour than answering questions about a complicated game.

Because interviewees always told the truth about the informal chat and fabricated a story about the game, it cannot be ruled out that the mimicry findings described in Chapters 3 and 4 were affected by the nature of the task and consequently the interview subject. The studies presented in Chapters 5 and 6 used a between-subjects design to compensate for this problem.

8.3 Cognitive Load Related Factors

With the early Chapters demonstrating the importance of cognitive load to the increased mimicry observed for liars, the latter Chapters examined the factors that moderated this relationship. The three key factors of language, culture and interview style were examined and the results are summarized in Table 8.1 and are discussed in more detail below.

8.3.1 Language.

The effect of performing the interview in the interactants' first or second language on mimicry in a deceptive setting was examined in Chapter 5. This Chapter shows that, when using a between-subjects design to investigate first language interviews, people mimic more when lying compared to telling the truth, while an opposite effect was found for second language interviews (i.e. people mimicked more when telling the truth compared to lying). Additionally, regardless of whether the interviewee was telling the truth or was lying, more mimicry occurred during second language interviews compared to first language interviews. These results partially support the cognitive load hypothesis. For example, the findings on first language interviews are in line with the results presented in Chapters 3 and 4, in which it was found that more mimicry occurs during fabrications compared with truths, due to the increased cognitive load of lying (DePaulo et al., 2003; Kassin & Gudjonsson, 2004; Vrij et al., 2010). Also, more mimicry occurred in second language interviews than in

first language interviews, regardless of veracity. This finding was hypothesized on the basis that second language use has been associated with increased cognitive load in previous deception research (Cheng & Broadhurst, 2005).

Table 8.1. Overview of the main mimicry results from Chapters 3-7.

Chapter	Mimicry result
3	- More mimicry occurred when fabricating lies compared to being truthful - Mimicry was correlated with cognitive load
4	- Mimicry increased with greater cognitive load - Mimicry occurrence was not correlated with attention
5	- More mimicry occurred in general during second language interviews compared to first language interviews - More mimicry occurred when lying compared to being truthful when conversing in a first language. The opposite effect was found for second language use.
6	- More mimicry occurred when interacting with people from the same cultural background compared to cross-culture interviews
7	- More mimicry occurred in information-gathering interviews compared to accusatory interviews when the same-culture interview was comprised of two low-context individuals. - More mimicry occurred in accusatory interviews compared to information-gathering interviews when the cross-culture interview was comprised of one low-context and one high-context individual.

Other findings from the second language study are less straightforwardly connected to cognitive load and may best be explained in a different way. Although the nonverbal mimicry findings of first language speakers were similar to the findings of Chapters 3 and 4, an opposite mimicry pattern arose in second language interviews. An alternative explanation for the finding that second language speakers mimicked more during truth telling than lying is the mimicry occurrence approach taken by Dunbar et al. (2011), who explained their mimicry result in liars as the effect of trying to restore credibility and the conversation flow, especially when met with suspicion by the interviewer. This explanation could be applicable to the second language mimicry results as well, because although not established in Chapter 5, both Cheng and Broadhurst (2005) and Da Silva and Leach (2011) found that interviewers tend to display a lie bias towards second language speakers, also when they are being truthful. This lie bias is likely to increase suspicion in the interviewer, which in turn may be picked up by the interviewee. Dunbar et al. (2011) used this explanation to explain the mimicry differences between truth tellers and liars, but the explanation may be more broadly applicable in this study due to increased interviewer suspicion regardless of veracity.

8.3.2 Culture.

The results presented in Chapter 6 partially support the cognitive load theory, but also highlight the importance of other culture-specific factors. It was argued that culture might impact mimicry in two different ways; through culture-specific communication preferences, and through disruptions of interpersonal processes due to violated expectations and lack of familiarity with the baseline behaviour of the interaction partner when interacting with individuals from a different cultural background. The results presented in Chapter 6 confirm a cross-cultural related

mimicry impairment, with more mimicry occurring during same-culture interviews compared to cross-culture interviews. This finding provided evidence for the importance of Bond et al.'s (1992) expectancy violation model during cross-cultural interactions, and further extended knowledge by showing its effect on interpersonal processes.

Surprisingly, in Chapter 6, mimicry did not differ between truthful and deceptive interviews for any of the cultural conditions, although veracity effects were previously found in Chapters 3, 4 and 5. Those studies only involved same-culture interviews with low-context individuals, providing a possible explanation for the absence of a veracity effect in the high-context and cross-cultural condition. Maybe culture impacts mimicry to the extent that it overshadows the veracity effect found in previous studies. From that perspective, problems with the recognition and interpretation of the behaviour of individuals with a different cultural background are likely to occur regardless of veracity. Similarly, the focus on communal orientation and interdependency of high-context communication will also be high regardless of veracity. However, the impact of culture on nonverbal mimicry cannot explain why there was no mimicry difference between truth tellers and liars in the low-context condition because participants in this cultural were culturally similar to participants used in previous experiments. Although the veracity effect for the low-context condition was in the right direction (i.e., more mimicry occurred during deceptive interviews compared to truthful interviews), the difference was not statistically significant.

Previous findings of veracity impacting mimicry were accompanied by increased cognitive load experienced by the interviewee when lying compared to truth telling. In contrary to previous results, interviewees were not more depleted when

lying compared to truth telling in Chapter 6. There are two explanations for the lack of a veracity effect on cognitive load; the implementation of a new cognitive load measure, or the lie paradigm was too simple to induce cognitive load. Firstly, in previous studies, cognitive load was measured with the use of a self-report difficulty question. In order to obtain a more objective load measure, the Ego State Depletion scale was administered (Janssen et al., 2008). Although the test was reliable with α = .94, it might measure a different construct than self-reported difficulty, which was found in Chapters 3 and 4 to correlate highly with nonverbal mimicry. An inadequate measurement of cognitive load may have caused the absence of a veracity effect on cognitive load. However, this does not explain why there was no veracity effect on mimicry. To investigate the possibility that the depletion scale was not a valid measure of cognitive load, in Chapter 7 two measures of cognitive load were used: the self-reported difficulty measure previously used in Chapters 3, 4 and 5, and the depletion scale from Chapter 6. Both cognitive load measures reported similar effects, such as the result that British interviewees found the interview more difficult than South Asian interviewees. However, the two cognitive load measures differed in their measure of the effect of interview style on self-reported difficulty and ego depletion. These findings provide partial evidence that the depletion scale and self-reported difficult measure a similar construct. Importantly, how closely this construct is actually related to cognitive load, is unknown. A more objective measure of cognitive load could provide a more robust explanation.

Secondly, the cognitive load measurement in Chapter 6 may have been adequate, but the lies may have been too easy. Participants in the lie condition were required to fabricate a story on how they would have played a game of ‘Never End’ on the computer using script knowledge. The second lie involved fabricating a story

of bringing a wallet to the lost-property box instead of revealing that they had removed a £5 note from this wallet. Participants were provided with information about the relatively easy to understand computer game and had time to prepare both lies. Maybe the combination of script knowledge (DePaulo et al., 2003), familiarity with the tasks, and the time interviewees had to prepare their lie (Vrij, 2008) has led interviewees to actually not find lying more cognitively demanding than truth telling. An actual lack of induced cognitive load difference between the truths and lies in the current study would explain why none of the cultural groups mimicked differently when telling truths and lies. To test this hypothesis, in Chapter 7 each interviewee was asked to tell both a truth and a lie. To build upon the results from Chapter 6, it was tried to increase lie difficulty, by choosing pre-interview tasks of a more complex nature and to give interviewees less detailed information when preparing their fabrication lie. The attempt to create lies that were more difficult than truths succeeded; interviewees reported that they found lying more cognitively demanding than truth telling. However, this difference in cognitive load did not affect mimicry.

Culture-sensitive results from Chapters 6 and 7 suggest that whenever individuals with different cultural backgrounds take part in the experiment, the effect of veracity on mimicry disappears. In Chapter 6, this lack of veracity effect may have been caused by the lies being to easy, but this cannot explain the lack of veracity effect on mimicry in Chapter 7. Rather, the lack of veracity effect in Chapters six and seven are likely to have been caused by the compounding effect of second language use. Second language use has been found to increase cognitive load and anxiety (Cheng & Broadhurst, 2005) and activate a lie bias (Cheng & Broadhurst, 2005; Da Silva & Leach, 2011). Both factors can affect mimicry. That second language use actually impacts nonverbal mimicry was shown in Chapter 5. When conducting

culture-sensitive research in a Western country, it is likely that high-context individuals do not only differ in their cultural background, but also in their native language. For example, in Chapter 6, 96% of the high-context participants conducted the interview in their second language. How second language use can pollute behavioural data is described in Chapter 5. In future research this issue should be circumvented by conducting second language experiments with an interviewer and/or experimenter who is fluent in both languages.

8.3.3 Interview style.

How interviewing style affects mimicry when interviewing low- and high-context interviewees was described in Chapter 7. This chapter showed that cultural background determined how an interviewee responded to different interview styles. Low-context interviewees mimicked most during information-gathering interviews, whilst high-context interviewees mimicked most during accusatory interviews. The mimicry result for low-context interviewees is best described via the cognitive load route because both low-context communication, due to its rational nature (Adair & Brett, 2004; Beune et al., 2009; Chapter six) and information gathering interviews, due to its longer and more detailed responses (Vrij et al., 2007), can be more cognitively demanding than high-context communication and accusatory interviews. Evidence that the interview really was more cognitively demanding for low-context interviewees compared to high-context interviewees was provided by both cognitive load measures. Also, in line with Vrij et al. (2006b), information gathering interviews were more depleting than accusatory interviews.

The interview style related mimicry results of interviews with high-context interviewees is less well explained from a cognitive load perspective, seen as more mimicry occurred during accusatory interviews with high-context interviewees,

compared to the, in theory, more difficult information-gathering interviews. One explanation is that information-gathering interviews were not more difficult than accusatory interviews, due to the choice for participant interviewers. Alternatively, this effect could have been caused by a high-context individual's preference for accusatory techniques, but a search through the existing literature suggests the opposite. Intimidating behaviour (Fu & Yukl, 2000) and the use of threats (Giebels & Taylor, 2009) have been found to be less effective in high-context cultures compared to low-context cultures. A better explanation for this result, has a similar rational to the explanation for the mimicry results in second language speakers, described in Chapter 5. This rational is based on Dunbar et al. (2011) and the indirect aspect of the IDT (Buller & Burgoon, 1996), and proposed that especially when met with suspicion, interviewees adjust their behaviour and use mimicry to appear more credible. Not only second language speakers are often met with suspicion by interviewers (Cheng & Broadhurst, 2005; Da Sillva & Leach, 2011), but this suspicion may also arise when interacting cross-culturally (Vrij & Winkel, 1991, 1994). Therefore, South Asian interviewees who were interacting with a British interviewer may have tried to restore the balance of the interaction by increasing their mimicking behaviour when met with suspicion. This effect may be particularly large when interviewers asked accusing questions because these questions may have been interpreted by interviewees as a sign of further increased suspicion. As a result, especially during accusatory interviews, South Asian interviewees may have mimicked the British interviewer more to reduce suspicion in the interviewer and to increase credibility.

8.4 Forensic Implications

The conclusions, like the impact of cognitive load on nonverbal mimicry and the need for culture- and language-sensitive research derived from this thesis have some implications for practice. First, nonverbal mimicry differs between truth tellers and liars in low-context interviews. Examining behaviour that naturally differs between truth tellers and liars provides the opportunity to measure something people are usually not aware of, and therefore will not try to control when lying. Therefore, lie detectors should, rather than focusing solely on the behaviour of the liar, take the interpersonal processes into account when attempting to detect deceit. The occurrence of mimicry can be estimated by the interviewer during the interaction, as a general rating, or by displaying certain behaviours and checking if this behaviour is copied or not. Alternatively, mimicry can also be automatically measured (e.g., remotely with the use of Kinect) in real-time during interviews, providing the interviewer with immediate objective feedback about the occurrence of nonverbal mimicry as a response to specific questions. Furthermore, this mimicry effect is correlated with the cognitive load experienced by the interviewee or suspect when lying. This provides interviewers with the opportunity to manipulate mimicry levels through deliberately increasing experienced load in the interviewee, for example by asking reverse order questions. Evidence for the effectiveness of recalling an event in reverse order, was provided by Vrij et al. (2008), showing that it enhances differences between truth tellers and liars on an individual's cues to deception (Vrij et al., 2008).

This thesis has shown that caution should be exercised when the interviewee is from a different cultural background than the interviewer, and when the interview is conducted in the interviewee's second language. Both culture and second language can disrupt the natural occurrence of nonverbal mimicry because of additional

cognitive load, culture specific responses and increased suspicion in the interviewer. More in general, Chapters 6 and 7 highlight the importance of taking the cultural background of the interviewee into account when examining deception (Taylor et al., 2013). In line with previous culture-sensitive studies conducted on behavioural differences between truth tellers and liars (Matsumoto, 2006), mimicry differed depending on cultural background in general, rather than lie-specific. Additionally, from Chapter 7 it became clear that the interviewee's cultural background should not just be considered when examining deception, but also when evaluating interviewing styles. Importantly, in both the mimicry effect for second language speakers in Chapter 5 and the cross-cultural mimicry effect in response to interview style in Chapter 7, the attitude of the interviewer was likely to have had a substantial effect on the mimicking behaviour of the interviewee. When possible, avoid having cross-language or cross-culture interviews. The police could facilitate this by taking cultural background and language skills into account when hiring personnel. When avoiding these cross-cultural and cross-language interviews is impossible, interviewers should at least be aware of the effect their behaviour and assumptions of guilt may have on the behaviour of the suspect and take this into account when attempting to detect deceit.

8.5 Future Research

Throughout the thesis, I made recommendations for future research regarding study-specific findings. I implemented some of the earlier recommendations in later studies described in this thesis, such as the use of a between subjects-design and the use of a double measure for cognitive load. The nature of this topic also lends for more general recommendations for future research. First, this thesis has revealed that, although people mimic differently when telling truths and lies, there are several other

factors that impact mimicry. Cognitive load seems to be the main factor of impact on mimicry in a deceptive setting. However, not all cognitive load effects were straightforward. The results described in Chapter 5 indicate that the relationship between mimicry and cognitive load may be u-shaped, rather than positive. In addition, three out of four tested factors in this thesis affect mimicry, and Chapter 7 touches upon the impact of additional social factors on mimicry, such as knowing the interaction partner. This suggests that there might be other social and cognitive factors relevant for mimicry research. This knowledge is not only beneficial for mimicry researchers, but investigating these factors will also provide with a more complete view on the effect of lying on interpersonal processes, which is necessary before a practical application of this knowledge can be used.

Second, this thesis has focused on the nonverbal mimicry aspect of interpersonal processes, but interpersonal processes exist of more than just nonverbal behaviour. Verbal behaviour has been used to detect deception through the use of linguistic analysis (Burgoon, Blair, Qin, & Nunamaker, 2003). Although there are no published papers on the use of verbal mimicry to detect deception, the use of verbal mimicry is promising because it can reveal information about the interactional dynamics of a situation. For example, information about group cohesiveness and task performance has been predicted with the use of Linguistic Style Matching, (Gonzales et al., 2010). How language use is affected by veracity and how nonverbal and verbal mimicry interact, would be interesting follow-up research.

Third, the natural occurrence of mimicry is now studied to reveal information about the interactional dynamics of a conversation. This knowledge can be used and further extended to advice on how to actively use the social aspect of mimicry to change interactional dynamics and impact the interviewee's behaviour. In Stel et al.

(2009), interviewers who mimicked the interviewee/suspect were worse at detecting lies than interviewers who did not mimic the suspect. In their study, interviewers were instructed to deliberately mimic the videotaped interviewee, which decreased detection rates. However, when implementing this strategy in an interactional setting, more positive consequences may arise due to the social aspect of mimicry. An interesting line of research would be to investigate if actively mimicking the interviewee/suspect would affect the interviewee's behaviour, for example by increasing cooperation or even decreasing their tendency to lie during the interview. In sum, more research is needed to investigate the potential of both verbal and nonverbal mimicry to reveal, or actively be used to impact interpersonal dynamics in a deceptive context.

Fourth, the use of motion capture techniques to automatically measure and analyse human's social behaviour should be applied to wider range of behavioural research. This will allow for a more objective and precise measurement of individual and group behaviour. Applications can be sought in for example sports science, health and rehabilitation and social psychology (Poppe et al., in press; Wright, 2008). The availability of motion capture systems that measure behaviour remotely allow for more ecological valid research designs and practical applications. First attempts have been made (Dael et al., 2012; Poppe et al., in press), but to fully benefit from the use of motion capture systems, further research should also be aimed at optimizing analysis techniques for different dependent variables and research questions. Finally, for the automatic analysis of behaviour to be applicable in practice (e.g., in the interrogation room), technology should be less intrusive and we should have a better understanding of a meaningful way to interpreter the data. The use of Kinect to

remotely measure body movement and this thesis are first steps in this direction, which could potentially bring a revolution in police interviews.

8.6 Final thoughts

This thesis has contributed knowledge about differences between truth tellers and liars, and specifically, how lying impacts on interpersonal processes. Most importantly, nonverbal mimicry naturally differs between truth tellers and liars in first language interviews with low-context individuals, with mimicry increasing with lie difficulty. There are three explanations that were connected to the occurrence of mimicry. First, the most influential factor of impact was cognitive load. Because lying is usually more cognitively demanding than truth telling and automatic processes increase under cognitive load, mimicry increased with lie difficulty. Cognitive load explained why mimicry increased with lie difficulty, when communicating in general in a second language and why low-context individuals mimicked more during the more difficult information-gathering interviews compared to the accusatory interviews. However, when other forensically relevant factors are active, different processes start gaining importance. The second factor of impact occurred when including a cultural component; the high mimicry occurrence in high-context pairs was best explained by the social perspective, in which culture-specific communication preferences led to an increase in mimicry. High-context individuals are more context oriented, rely more on nonverbal strategies when communicating and are more perceptually attuned to others, which increases their tendency to mimic. Thirdly, although not verifiable based on our date, an interesting explanation for the second language mimicry in response to veracity results and the cross-cultural mimicry effect in response to interview style seemed caused by increased suspicion in the interviewer due to second language use and differences in cultural background. According to the

indirect aspect of the IDT, when encountering a suspicious interviewer, interviewees may try to restore the interaction balance by increasing their mimicking behaviour, in order to increase their own credibility. In the literature so far, this explanation has only been used to explain why liars mimicked more than truth tellers. However, one could argue that this restoring of the interaction balance may not only occur when actually being suspicious (i.e., whilst lying), but may also occur when being honest, but, for a reason other than lying, are perceived to be by the interviewer. In this scenario, people may feel they are being judged unfairly and consequently try to convince the interviewer of their honesty with the use of mimicry. When an unfair judgement of dishonesty leads interviewees to increase their mimicking behaviour, an effect normally found when lying, innocence may actually put innocents at risk (Kassin, 2005). For example, when interviewers are increasingly suspicious, and this suspiciousness is caused by second language use in the interviewee, interviewees may feel they have to restore this imbalance especially when they are actually telling the truth, leading to an increase in mimicry in second language users, especially when being truthful.

My findings also have several implications for other deception researchers. First, although lying is usually perceived to be more cognitively demanding than truths, I found that lying, especially when concerning concealments, were not always more difficult than truth telling. This is useful knowledge when designing deception experiments. Secondly, communicating in a second language and cultural background, both in same- and cross-culture interviews, affected the interviewee's behaviour. Because many deception experiments are conducted with university students, and universities are known to have a diverse student population, deception researchers might want start taking the cultural background of participants into

account as a standard. Last, this thesis has shown the benefits of measuring behaviour automatically rather than by manually coding videos. Mimicry is just one example of nonverbal behaviour that can be measured with this technique. With this method, any type of movement can be studied objectively and into much detail, providing many new and improved research methods in several research fields, including deception.

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APPENDIX A: INTERVIEW QUESTIONS CHAPTER 7

A.1. Information-gathering questions - Virtual Tour Louvre

I was told you were here doing a virtual tour through the Louvre museum. I would like to ask you some questions about this tour.

1. Can you tell me, into as much detail as possible, what happened when you were doing the virtual tour?
2. Can you please describe to me, into as much detail as possible, what you saw during this virtual tour?
3. Can you please tell me everything you have learned about the Louvre today, that you did not know before?

Now I will ask you some more specific questions. You may have already answered them, but if that's the case, please answer them again.

4. Please tell me where you were when doing the virtual tour.
5. How did you decide to start doing the virtual tour?
6. Which part of the Louvre museum did you visit during your tour?
7. What was the first room in the museum you entered?
8. Please describe what the inside of the museum looked like?
9. Can you describe what the layout of the museum looked like?
10. What did you have to do to move from room to room?
11. How did you decide which room to go into?
12. In chronological order, which rooms did you visit?

13. Can you tell me all about the piece of art you found most impressive?
14. You were given a sheet with 3 questions about the virtual tour. What were they about?
15. How did you try to find out the answers to the questions?
16. Can you tell me as much as possible about the answers you found?
17. What did you think of the virtual tour?

A.2. Accusatory questions - Virtual Tour Louvre

I was told you were here doing a virtual tour through the Louvre museum. I would like to ask you some questions about this tour.

1. Can you tell me, into as much detail as possible, what happened when you were doing the virtual tour?
2. Can you please describe to me, into as much detail as possible, what you saw during this virtual tour?
3. Can you please tell me everything you have learned about the Louvre today, that you did not know before?

Now I am going to ask you some more specific questions about this tour. Even if you have already answered them, I would like you to answer them again.

4. Did you actually do the virtual tour?
5. Where were you when doing the virtual tour?
6. How did you decide to start doing the virtual tour?
7. Which part of the Louvre museum did you visit during your tour?

8. Did you really do the virtual tour?
9. What was the first room in the museum you entered and how did it look like?
10. What did inside of the museum look like?
11. And what did the layout of the museum look like?
12. Are you sure you did this virtual tour?
13. What did you have to do to move from room to room?
14. In chronological order, which rooms did you visit?
15. If you actually did this virtual tour, like you are claiming, you must have liked some of the art pieces. Describe to me the one you liked best.
16. Your reactions make me think that you are hiding something from me. I will ask you again, did you do the virtual tour, or are you lying to me?
17. I was told you were given a sheet with 3 questions about the virtual tour. What were they about?
18. Tell me what you did to find out the answers to the questions?
19. Can you repeat the answers to me now?
20. If you actually had done the virtual tour, wouldn't you have been able to answer the questions better?
21. I will ask you one last time, have you done the virtual tour or not?

A.3. Information-gathering questions - Art Exhibition Library

I was told you went to the Library on campus to visit the art exhibition. I would like to ask you some questions about this visit.

1. Can you tell me, into as much detail as possible, what happened when you visited the Art exhibition at the Library?

2. Can you please describe to me, into as much detail as possible, what you saw during this visit to the Art exhibition?
3. Can you please tell me everything you have learned about the Library on campus today, that you did not know before?

Now I will ask you some more specific questions. You may have already answered them, but if that's the case, please answer them again.

4. Please tell me how you got to the Library.
5. How long did it take you to get there?
6. Please tell me everything you saw on your way to the library.
7. What did you see upon entering the library?
8. How did you decide which room to go into?
9. Where was the art exhibition located in the library?
10. Can you describe to me what the different art pieces looked like?
11. In chronological order, which activities did you undertake whilst in the Library?
12. Can you tell me all about the piece of art you found most impressive?
13. You were given a sheet with 3 questions about the art exhibition. What were they about?
14. How did you try to find out the answers to the questions?
15. Can you tell me as much as possible about the answers you found?
16. What did you do after finishing answering the questions?
17. What did you think of the art exhibition?

A.4. Accusatory questions - Art Exhibition Library

I was told you went to the Peter Scott Gallery on campus to visit the pottery exhibition. I would like to ask you some questions about this tour.

1. Can you tell me, into as much detail as possible, what happened when you visited the Art exhibition at the Library?
2. Can you please describe to me, into as much detail as possible, what you saw during this visit to the Art exhibition?
3. Can you please tell me everything you have learned about the Library on campus today, that you did not know before?

Now I am going to ask you some more specific questions about this visit. Even if you have already answered them, I would like you to answer them again.

4. Did you actually visit the art exhibition in the library?
5. How did you get to the library?
6. How long did it take you to get there?
7. What happened on your way to the library?
8. Did you really walk to the library?
9. What did you see upon entering the library?
10. Where was the art exhibition located in the library?
11. Describe all art pieces to me
12. Are you sure you visited the library?
13. What did the art exhibition room look like?

14. In chronological order, which activities did you undertake whilst in the library?
15. If you actually went to the art exhibition, like you are claiming, you must have liked some of the art pieces. Describe to me the one you liked best.
16. Your reactions make me think that you are hiding something from me. I will ask you again, did you go to the art exhibition, or are you lying to me?
17. You were given a sheet with 3 questions about the art exhibition. What were they about?
18. How did you try to find out the answers to the questions?
19. Can you repeat your answers to me now?
20. If you had actually visited the art exhibition, wouldn't you have been able to answer my questions better?
21. I will ask you one last time, have you visited the art exhibition in the library?