**The Effect of Valence and Veracity on Facial Mimicry**

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**Abstract**

The objective of this study was to examine how facial emotional mimicry varies in receivers of truthful or dishonest information and whether there is an impact of the valence of the message. For this, the study applied facial expression analysis software instead of relying on human coding. There was expected to be more facial mimicry of positive stories and truths compared to negative stories or lies based on the desire to affiliate with the counterpart. In a within-subjects experimental setup, 26 participants watched 16 videos, balanced for truthful and deceptive content, with either positive or negative valence. While watching the videos, their facial expressions were captured and categorised by the iMotions software as positive or negative for further analysis. After each video, participants judged the perceived veracity and rated the valence of the person and of the message. These expressions were compared with emotional expressions displayed by the people in the video stimuli to obtain mimicry scores. Results show that, when the story was true, there was more positive mimicry of negatively valenced stories, more mimicry of lies, and more mimicry of negative statements. Outcomes challenge existing literature, suggesting new perspectives on mimicry as a measure and highlighting the potential dangers of using automated software.

## The Effect of Valence and Veracity on Facial Mimicry

People often say things that are not entirely truthful. Even though a person lies on average once or twice a day (Verigin et al., 2019), humans still have trouble accurately detecting them. Indeed, the accuracy of detecting deception is not far from guessing, which is about 50 per cent accuracy of the message received (Bond & DePaulo, 2006). This shows that the underlying psychology of lying is versatile and complex, which is why many psychologists, researchers, and law enforcement personnel have been working to gain more insight into the complexities of deception and responses to being deceived.

Determining how peoples' lies affect others and identifying potential lies is crucial as it affects individuals and society in various contexts. One way to assess statements' accuracy is to focus on liars' nonverbal behaviour. When considering nonverbal cues, Zuckermann et al. (1981) found that senders can control their facial expressions better than their body language as they are more aware of their faces. However, research has so far not clearly shown reliable cues to deception from observing the sender. That is why shifting this focus from the sender to the receiver may be more promising, with mimicry being a crucial factor as people unconsciously mirror the facial expressions they observe in others (Duffy & Chartrand, 2015).

People tend to mimic others when they desire to affiliate with them (Lakin & Chartrand, 2003). Knowing that, the question arises whether the desire to affiliate decreases when being lied to or presented with negative messages. Additionally, a particular type of mimicry, emotional mimicry, has been identified and occurs in almost every social interaction (Duffy & Chartrand, 2015). Emotional mimicry occurs unconsciously and can be described as mimicking the emotional expressions of another, thus displaying corresponding nonverbal emotional expressions (Hess & Fischer, 2014). Connected to affiliation goals, this type of mimicry is an

unconsciously activated behavioural expression (Duffy & Chartrand, 2015). The leakage hypothesis suggests that people cannot wholly suppress deception-related emotions, which might expose the lie (Vrij et al., 2019). Therefore, with the occurrence of mimicry, the behaviour of the receiver of a message might reflect evaluations of senders and sent messages within their facial expressions. These facial expressions can be seen as a potential benefit for automated lie detection compared to training humans in identifying microexpressions for lie detection, as there is a higher chance of capturing fleeting changes in expressions (Jordan et al., 2019).

Now, the focus is to investigate to what extent the mimicry of emotions differs based on the differences in messages told. This type of mimicry can be analysed using the Facial Expression Analysis (FEA) by iMotion. With that and the emergence of new technological software, this study aims to capture emotional expressions displayed in the faces of the receiver of either truthful or dishonest messages, which are either positively or negatively valenced. Therefore, the rationale for this study is to address the following question: To what extent is watching positively or negatively valenced lies compared to truths associated with differing levels of facial mimicry?

**Deception**

When referring to lies, a subtype of deception is meant. Deception itself can be defined as "intentionally, knowingly, or purposefully misleading another person" (Levine, 2014, p. 380) by which a lie is a message that is used and actively known to be wrong by the one who says it and not declared as false to the recipient (Levine, 2014).

Motivation for deception can be multifaceted. One distinction often made is between prosocial lies that aim to benefit and protect the receiver and antisocial lies that intend to harm the counterpart (Levine & Lupoli, 2022). As the motives for lying are not all negative, it must be

acknowledged that lying is part of everyday life and can also be highly adaptive and essential for survival. (Zuckerman et al., 1981). Prosocial lies are often intended to prevent emotional harm to the person being lied to and can consequently enhance trust in the liar and their positive moral assessment (Lupoli et al., 2017). Especially in close relationships, altruistic lies are common. They can occur, for example, in the form of compliments, claiming to understand the other person, or pretending to agree with them (DePaulo & Kashy, 1998); thus, being bad at lying and potentially getting caught more easily could disrupt such relationships.

Although not all lies are harmful, they can still be, which makes it essential to comprehend how individuals receive and process deceptive messages of varying types. When people try to assess whether they are being deceived, they must attend to the cues first, interpret them afterwards, and judge their veracity (Zuckerman et al., 1981). Most people tend to be poor judges of deception, with police officers showing only a slightly higher level of accurately determining deception than civilians, both holding similar ideas about detecting deception (Delmas et al., 2019). Consequently, humans generally tend to lack skills in accurately assessing deception. This difficulty highlights the importance of considering various factors that might influence deception and its assessment. Among these factors, nonverbal cues are particularly crucial, as they play a significant role in how people judge the veracity of messages and the behaviour of those involved.

**Nonverbal Communication and Deception**

Various theories that predict nonverbal cues to deception have been proposed, such as Ekman and Friesen's (1969) leakage approach or Zuckerman, DePaulo, and Rosenthal's (1981) multifactor model. Nonverbal behaviours include facial expressions, body position, posture, and movement (Fichten et al., 1992). Moreover, nonverbal communication relates to various domains

of communication and expression, including displaying affect, revealing attitudes, regulating interaction, and managing impressions (Hall et al., 2019).

Those theories suggest that people who deceive behave differently than truthful people. Specifically, people who deceive try to control their behaviors, thoughts, and feelings as much as possible to not expose themselves (DePaulo et al., 2003). Compared to people telling the truth, who also display some of these behaviours, liars put in more deliberate effort (DePaulo et al., 2003). However, some nonverbal behaviours are more challenging to control than others. Additionally, people seem to have trouble controlling their overall body movements when lying, as joint displacements account for almost 75% of lie indications (Van der Zee et al., 2019). Thus, as opposed to preconceptions, people tend to move a lot and do not freeze while lying. Therefore, nonverbal behaviour can give hints about how a deceiver acts. However, current research is debating the quality of evidence for using nonverbal behaviour as a reliable tool for deception detection because nonverbal cues are rather weak and unreliable, implying inconsistencies in behaviour displayed (Vrij, 2019). Therefore, new approaches need to be implemented to gain further insight into how to measure deception accurately. One approach applied in this study is shifting the focus to the receiver of cues.

**Receiver of Cues**

The perceiver of a message can only make reliable inferences from nonverbal cues if those are accurately attended to and perceived as indicative of deception. This requires an initial observation of the cue, followed by recognising it as a deceptive cue and correctly integrating it with all other cues to make a final judgment (Zuckerman et al., 1981). One helpful framework for making those judgments is summarised in the lens model presented in Figure 1. The lens model adapted to deception outlines this process of identifying the most relevant ones while

minimising biases (Hudson et al., 2020). First, the validity of cues in detecting deception is

assessed. Next, as highlighted in the figure, how the participants utilise the cues given is one

primary mechanism, as they might give more weight to specific cues than others. Additionally,

observers integrate multiple cues to form their judgments about deception to make a final

judgment. Those inferences are made quickly; it takes a person less than 100ms to make

judgments about the other person's state (Hall et al., 2019). Especially emotions displayed by

their counterpart play a role in making those inferences to attribute and categorise such cues

correctly.

**Figure 1**

*Schematic Representation of the Lens Model Adapted to Deception Cues.*
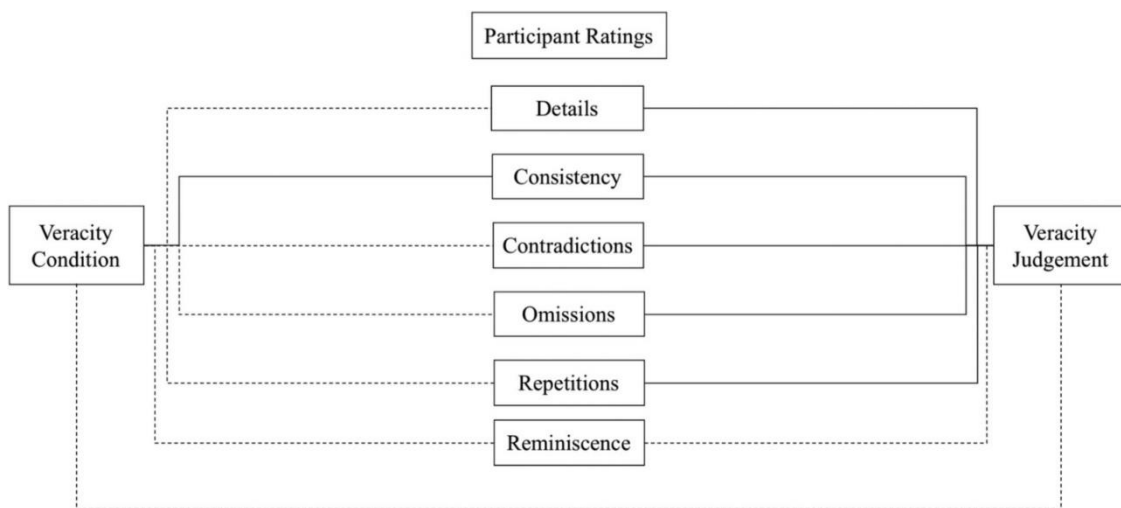


*Note.* The lens model adapted to deception cues, representing the effects of participant ratings of

between-statement consistency on veracity judgment and accuracy of identifying veracity

conditions. Bold lines signify p $<$ *.001*; dotted lines are not significant (Hudson et al., 2020),

showing how participants evaluate specific cues to be critical in deception detection and whether

they help identify deception accurately.

**Emotional Expression**

Before emotions can be attended to, they need to be expressed by a person. Basic emotion theory explains how emotions are displayed and described. In that theory, emotions are described as "distinct and brief states involving physiological, subjective and expressive components that enable humans to respond in ways that are typically adaptive […]," which are claimed to be universal (Keltner et al., 2019, p.133).

Whether liars express more positive than negative emotions is still somewhat unclear as there is evidence for both, and it highly depends on the contents of the lies. According to Newman et al. (2003), liars use more negative emotion words, which might also affect the emotions expressed in their faces. DePaulo et al. (2003) argue that liars generally seem more tense and negative. However, in terms of self-presentation, liars might use more positive framing and exaggerate their positive aspects (Mun & Kim, 2021). Overall, the framing of lies highly depends on their motivation and purpose, suggesting differences in positive and negative displays. Since individuals unconsciously mirror facial expressions and emotions when engaged in a conversation, these differences in emotional expressions can influence how they are mimicked.

**Emotional Mimicry**

The valance, namely how positive or negative certain statements are, and perceived emotions of lies or truths might play a crucial role as different emotions impact mimicry differently (Deng & Hu, 2018). When considering valence, mimicry is more present in the context of positively valenced situations than in negative ones (Kovalchuk et al., 2022), which might depend on the desire to affiliate and this being more present in positively valenced statements than negatively valenced ones (Hess, 2021). This suggests that people might mimic

more positive emotions to affiliate and mimic less when they perceive someone as negative or lying.

Affiliation and other factors, especially the social context and relationship with the person being mimicked, impact the extent of emotional mimicry. The context of the interaction is essential as it entails transmitting the origins and purposes of one's emotions. Therefore, emotional mimicry does not only happen when observing someone else but also when considering their emotional intentions (Duffy & Chartrand, 2015). Empathy plays a key role in showing whether expressions are understood (Hess & Fischer, 2014). With that, inhibiting mimicry seems to reduce the perceived credibility of people's counterparts, as this might decrease their cognitive empathy (Ask, 2018). Further, Hess & Fischer (2014) found that people show less mimicry when they do not like the person they attend to, implying that liking someone interplays with facial responses. Additionally, they argue that antagonistic facial expressions are less likely to be mimicked. Therefore, the extent of mimicry depends on the person being mimicked, the relationship with that person, and the emotion displayed, as there is more of a burden to mimic antagonistic emotions than affiliative smiles (Hess & Fischer, 2014). Therefore, the contributing factor to analysing receivers' mimicry is to investigate whether there are apparent differences between the mimicry displayed by liars and truth-tellers across differently valenced types of lies. Affiliation and empathy as contributing factors to influencing mimicry indicate that there might be more mimicry in positive rather than negative situations and valences of statements and even less mimicry in negatively valenced lies. Mimicry is shown to be complex and unconscious, highly depending on context and relationships. As this often results in issues for human coders, analysing mimicry using automated software might be more promising.

**Facial Expression Analysis**

Automated software may be more beneficial in capturing facial expressions because humans cannot accurately rate facial mimicry (Weiher et al., 2023). In the past, Electromyography (EMG) techniques have commonly been used for such analyses (Kulke et al., 2020). EMG techniques are less efficient than newer techniques as they utilise electrodes and other technical equipment that must be installed. Newer techniques, such as the Affectiva technology by iMotions, only require video recordings of the faces to be analysed, enhancing efficiency. This tool is more accessible and potentially used in practice than the more complicated EMG experiment methods. Kulke et al. (2023) concluded that Affectiva technologies can be as good at measuring facial expressions as EMG techniques. Therefore, automated techniques such as Affectiva were shown to be promising in measuring facial emotions to investigate differences in potential effects of valence and veracity relevant to this study.

**Current study**

Deception and its effects on human behaviour are complex, leading to various creative approaches investigating the underlying mechanisms. The approach in this study is to investigate whether manipulations of veracity and valence affect mimicry and whether mimicry measures can be used to identify cues to deception. A basis for this is that mimicry occurs automatically and unconsciously and is usually influenced by affiliation goals (Hess & Fischer, 2014). The current study builds on a conducted study by Nau (2023), which was limited by the insufficient resolution of stimuli to identify the people's expressions in the videos clearly. In those videos, the stimuli's faces were often covered by hands. However, the video stimuli used in the study by Nau (2023) showed high-stakes deception, which is exchanged with lower-stakes deception in

the current study. Nevertheless, these are more related to day-to-day lies that participants are often confronted with. The focus here is more on a higher quality of videos to identify the emotions displayed properly. Additionally, the current study extends the former in exploring the effects of valence on mimicry. All this leads to the following hypotheses tested within the scope of the study:

H1a: *People will produce less facial emotion expression mimicry when presented with lies rather than truths because people are expected to affiliate more with truth-tellers than liars.*

H1b: *People will produce more facial emotion expression mimicry when presented with positive rather than negative stories because the desire to affiliate is expected to be more present in positive stories.*

H2: *Since valence and veracity are supposed to influence each other with positive truths eliciting more positive responses and vice versa based on the desire to affiliate with the person speaking, it is expected that:*

H2a: *People will produce more positive mimicry when presented with positively valenced truths.*

H2b*: People express more negative mimicry when presented with negatively valenced lies than truths.*

H3: *There is a positive association between veracity judgment and mimicry, with more mimicry being present when the message is perceived as less deceptive because truth-tellers exert less control over their expressions.*

H4: *There will be a positive relationship between the evaluation of the speaker (positive vs. negative) and the extent of facial mimicry based on the desire to affiliate.*

**Methods**

**Design**

The study employed a within-subjects 2×2 model with two independent variables: valence (positive vs. negative) and veracity (truth vs. lie). The dependent variables were mimicry, divided into mimicry (of positive and of negative emotions) and veracity judgment (direct and indirect). Indirect judgments were composed of thinking hard, indifference, verbal immediacy, cooperativeness, and behavioural change. Additional dependent variables, the impression of the speaker, perceived valence, and display of positive and negative emotions, were used for explorative analyses.

**Participants**

The recruitment for this study followed the convenience sampling method as it was published on the University of Twente's Sona Systems website and made available for university students who received 1.5 credits for their course study participation requirements. Eligibility required participants to be above 18 and proficient in English. Additional recruitment methods were asking private contacts and distributing flyers. Finally, there were 26 participants after omitting non-consented data of two participants, of whom 19 (73.1%) were German, 3 (11.5%) were Dutch, 3 (11.5%) were of other nationalities, and 1 (3.8%) did not give information. Their age ranged from 18 to 27 years ($M = 22.4$; $SD = 1.9$); 16 (61.5%) were female, 9 (34.6%) male, and 1 (3.8%) did not give information on their gender. 20 (76.9%) indicated having completed high school, 1 (3.8%) secondary school and 7 (26.9%) had completed a university bachelor's degree before.

**Materials**

*Videos*

16 of the 320 video stimuli from the Miami University Deception Detection Database were chosen (Hugenberg et al., 2017). The selected people displayed in the videos were white, with an equal number of male and female persons representing the targeted participants the most, creating increased in-group feelings important for mimicry (Bourgeois & Hess, 2008). The videos displayed four persons, with one person speaking per video. There were two males and two females speaking about their social relationships. Half of the videos contained lies, and the other half contained truths, both varying in their valence. Consequently, half of the videos were positive, and the other half negative. The people displayed in the videos were given instructions and told to describe people they truly like and describe their positive features in the first video. In the second, they were told to describe the same person but lie about them and emphasise their negative features. In the third and fourth, they have been given the opposite instructions, describing someone they truly dislike negatively and then lying about that person positively (Lloyd et al., 2019). Thus, each person is displayed in four different videos, including a positive truth, a positive lie, a negative truth, and a negative lie, and every participant saw all four videos of each speaker. Each video lasted about 30 to 40 seconds. People chosen from the database are indicated in Appendix A.

*Questionnaires*

All scales used in the study can be found in Appendix B.

**Preconceived Ideas.** First, a short questionnaire about the participants' preconceived ideas about lying was given to measure the extent to which people believe different assumptions about the behaviours of liars to be true. Those include, for example, "I believe that people who

lie avoid eye contact" or "I believe that people who lie fidget more with their fingers," which were answered on a 7-point Likert scale (see Appendix B1). This questionnaire was included for future analyses but has not been discussed or analysed as part of this thesis.

**Veracity Judgment.** Next, a questionnaire regarding their judgment on the veracity of the people in the videos was used. A distinction between direct and indirect veracity judgments was made to measure explicit and implicit opinions, reduce socially desirable answers, and include unconscious attitudes. Indirect questions have been asked as this serves to pay attention to the particular cues that are actual indicators of deceit, as Vrij et al. (2001) found that police officers could only distinguish between truths and lies using indirect methods. In total, 12 questions were posed, of which two were connected to the direct veracity judgment. One direct veracity judgment item was: "The person in the video told the truth," and the other one was "The person in the video was lying.". The other ten indirect questions included different distinctions: thinking hard, indifference, verbal immediacy, cooperativeness, and behavioural change. For each of these, two questions were posed. Examples of the indirect questions are: "The person in the video seemed willing to tell their story" and "The person in the video seemed uninterested in what they were saying" (see Appendix B2). After reverse scoring relevant questions, the means of scores for direct veracity and indirect veracity judgment have been computed and merged into two distinct variables, one representing a direct veracity judgment score and the other an indirect veracity judgment score. With that, high scores indicated more belief in being deceived. Overall, the indirect veracity judgment questions show acceptable reliability with Cronbach's alpha of $\alpha = .7$.

**Explorative Questions.** Finally, three questions were asked to measure the valance's perception, the displayed person's evaluation, and the accuracy of capturing whether people

thought the truths or lies were more complete. The last question was not analysed. The first two questions check whether perception aligns with expression and to what extent they liked the person in the video to check for affiliation goals. These include: "How positive or negative did you find the description of the person in the video?", "What impressions did you get of the person in the video?" and the last was "How accurately do you think the description of the person in the video was?". The first two ranged from extremely negative to extremely positive on a 7-point scale. The last one ranged from extremely accurate to extremely inaccurate on a 7-point scale.

### Electronic Devices

A Logitech C310 HD webcam was used to record the participants' faces and upper bodies. The audio was relayed through over-ear headphones.

### Software

The data was recorded and collected using the Facial Expression Analysis (FEA) software module by iMotions (iMotions, 2022). The software automatically encoded facial expressions recorded by a webcam, and version iMotions 10.0 was used. The software allows the stimuli presented to be aligned with the video recordings of the participants' faces in real-time. Additionally, there are options to display different signals of the Affdex technology, from which "Valence" was chosen to analyse the difference between the mimicry of positive and negative emotions.

Delta scores that represent the differences in the percentage of reaching a 50% threshold of facial emotion frames were used to examine whether there is a difference in the mimicry of speakers in the stimuli and participants. Those delta scores have been calculated particularly for valenced mimicry scores, thus, for mimicry of positive and negative emotions distinctively.

Thus, there has been one variable indicating the discrepancy between facial emotional expressions displayed by video stimuli and the participants for the mimicry of positive emotions and one variable indicating the discrepancy for the mimicry of negative emotions. These two variables were calculated by aligning the facial emotional frames to ensure that expressions followed each other in time. The software indicates values for valence in a range between 0, representing no facial emotional expression, and +100, representing 100% of frames captured the positive or negative emotion expressed. Next, delta scores represent the difference between emotions expressed by the speaker in the video stimuli and those expressed by the participants. Therefore, high values indicate a mismatch with more emotions displayed by the speaker in the video stimuli than by the participant. Values closer to 0 indicate a match between the emotions displayed by both and, thus, more mimicry or no facial emotions expressed by both parties. Negative values indicate that the participant displayed more emotions than by the speaker in the video stimuli. These delta scores of mimicry of positive and negative emotions were transformed into positive values, with higher values indicating a greater disparity in mimicry and lower values indicating higher mimicry of emotions for the analyses. The software was used for data collection, after which the data was exported for further analysis in R (version 4.4.0).

**Procedure**

Before collecting data, the University of Twente Ethics Committee provided ethical approval for the study (reference number 250178). Each participant had to sit in front of a computer with a webcam. They were presented with an informed consent form educating the participants about the study, ethical considerations, data handling, and a declaration that they could withdraw at any time (see Appendix B3). After agreeing to the privacy terms and briefing of the study, questions concerning the demographic data were asked (see Appendix B4).

Demographic data includes their age, nationality, gender, and highest academic achievement. Additionally, questions about their preconceived ideas about lying were asked. Next, the 16 videos across all veracity and valence conditions were shown in a random order. After each video, participants had to fill out the direct and indirect veracity questions and the three questions concerning valance, affiliation, and accuracy. Each participant watched 16 videos from four speakers, each telling a positive and negative lie and truth. Afterwards, in case the participant had any questions concerning the study were answered, the participants were debriefed (see Appendix B5). Data collection was done in April 2024, and the completion of the experiment lasted about 40 minutes.

**Data Preparation and Analysis**

There were 507 missing values in the veracity judgment questionnaires, and two in the questions on the impression of the speaker, which were not used when calculating scale means. The demographic data was analysed using descriptive statistics. Spearman correlation checks were performed between all dependent variables, variables of the impression of the speaker, perceived valence of the video, and display of positive and negative emotions. Two main models were performed, with positive and negative mimicry as the outcome variables, veracity and valence as the predictor variables with two levels each, and two non-crossed random effects for the speaker and one random effect for respondents. After assumption checks of a mixed effects model of mimicry of negative emotions have shown a high proportion of 0 scores, one generalised linear model for the mimicry of negative emotions with any versus no discrepancy in mimicry as two levels in the outcome variable. Assumption checks showed improved conditions, but there were some tendencies for unequal variance and dependence on respondents. Additionally, one mixed effects model for the mimicry of positive emotions was applied.

Assumption checks for this model were done and met key assumptions, which can be found in Appendix C2. Further follow-up simple effects analyses have been applied for any significant interaction effects.

## Results

Table 1 contains mean scores, standard deviations, and correlation scores between direct and indirect veracity statements, mimicry of positive and negative emotions, impression of the speaker, perceived valence scores, and positive and negative emotions expressed by the participants. Furthermore, all significant correlations are highlighted in the table.

Moreover, there were some strong significant correlations: one negative relationship between direct and indirect veracity judgment, a positive relationship between impression and perceived valence, and a negative relationship between mimicry of negative emotions and negative emotion. The relationship between indirect and direct veracity judgment suggests that the more someone thought to be deceived and indicated this directly, the less that person indicated this through the indirect questions and vice versa. Perceived valence significantly correlated with all variables except positive and negative emotional expression. Furthermore, there was more mimicry of positive emotions when there was also more mimicry of negative emotions, indicating that some people express more mimicry than others.

No association was found between the relationships between direct and indirect veracity judgments and mimicry of positive emotions. However, the correlations between both types of veracity judgment and mimicry of negative emotions were small but significant, leading to an acceptance of hypothesis H3 for the mimicry of negative emotions with more mimicry displayed, the less they directly perceived the deception to be. The hypothesis cannot be accepted for indirect measures as a lower deception belief was related to lower mimicry of negative emotions.

Moreover, the relationship between the impression of the speaker and mimicry of positive emotions shows that the more positive someone was evaluated, the less mimicry of positive emotions was present. Additionally, the more positive someone was perceived, the more mimicry of negative emotions was present. Therefore, H4 can only be accepted for mimicry of negative emotions.

**Table 1**

*Descriptive Statistics and Correlations for Dependent Variables, Impression of the Speaker, Perceived Value of the Video, and Positive and Negative Facial Emotions Expressed by the Participants.*

|  | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Direct Veracity Judgment | 3.30 | 1.30 | - | | | | | | | |
| 2. Indirect Veracity Judgment | 4.10 | 0.80 | *-.64* | - | | | | | | |
| 3. Positive Mimicry | 76.57 | 31.10 | -.06 | -.04 | - | | | | | |
| 4. Negative Mimicry | 31.81 | 4.90 | *.12* | *-.10* | *-.16* | - | | | | |
| 5. Impression | 3.81 | 2.03 | *-.15* | -.07 | *.22* | *-.32* | - | | | |
| 6. Perceived Valence | 3.91 | 1.44 | *-.38* | *.18* | *.23* | *-.28* | *.58* | - | | |
| 7. Positive Emotion | 3.11 | 6.06 | .02 | -.05 | *-.22* | -.03 | -.02 | .02 | - | |
| 8. Negative Emotion | 1.69 | 3.35 | -.01 | .03 | -.07 | *-.58* | -.01 | -.01 | .01 | - |

*p* < .05, *p* < **0.01**, *p* < **0.001**.

*Note.* Direct and Indirect Veracity Judgments ranged from 1 to 6, with higher values indicating a higher deception belief. Higher values in Positive and Negative Mimicry indicate more deviant mimicry scores, while lower values indicate more accurate ones. Impression and Perceived Valence scores ranged from 1 to 7, representing extremely negative (1) to extremely positive (7). The higher the Positive and Negative Emotion scores were, the more emotions were expressed.

**Mimicry of Positive and Negative Emotions**

Table 2 shows the outcomes of the linear mixed effects model for mimicry of positive emotions and the generalised linear model.

There was a significant main effect of veracity on the mimicry of negative emotions, with more mimicry of negative emotions for lies rather than truths. However, the main effect of veracity on the mimicry of positive emotions has not been significant. Therefore, H1 can not be accepted.

Next, both main effects of valence significantly affect mimicry scores, with a higher probability of displaying mimicry of negative stories than positive stories. This indicates that there was more mimicry of negatively valenced stories, leading to a rejection of H2.

The interaction effect between veracity and valence was not significant, leading to a rejection of H2b. There is no evidence that the combination of valence and veracity has a different effect on the mimicry of negative emotions. Additionally, there was more variance in the amount of mimicry of lies compared to truths.

As there has been a significant interaction between valence and veracity on mimicry of positive mimicry, follow-up simple effects analyses have been performed where estimated marginal means for all effects are calculated since the model includes random effects. For the effect of valence within veracity, Figure 2 shows that when stories were false, there was a significant difference in mimicry between positive and negative valence ($p < .001$), with positive valence indicating less mimicry. When stories were true, there was also a difference with positive valence indicating greater disparity in mimicry ($p = .027$). It can be concluded that when stories were true, there was more mimicry of positive emotions when the story was negatively valenced, leading to a rejection of H2a. For the effect of veracity within valence, there was no

significant difference between truths and lies on mimicry of positive emotions when the story

was negative ($p = .92$). However, when valence was positive, there was less mimicry of positive

emotions when the story was a lie ($p < .001$). Overall, people are more likely to mimic positive

truths than positive lies but are more likely to mimic negative emotions compared to positive

emotions regardless of veracity.

**Table 2**

*Main outcomes of the mixed effects model and the generalised linear model.*

| Independent Variables | Dependent Variables | | | |
|---|---|---|---|---|
| **Fixed effects** | | | | |
| | Positive Mimicry | | Negative Mimicry | |
| | *M* | *SE* | *probability* | *SE* |
| Veracity | - | - | - | - |
|     Truth | 72.6 | 13.2 | 0.92 | 0.04 |
|     Lie | 80.6 | 13.2 | 0.59 | 0.11 |
| Hypothesis tests | $F = 0.01$ | $df = (1,423)$ | $F = 55.34$ | $df = (1,424)$ |
| | | $p = .9$ | | $\boldsymbol{p < .001}$ |
| | Positive Mimicry | | Negative Mimicry | |
| | *M* | *SE* | *probability* | *SE* |
| Valence | - | - | - | - |
|     Positive | 83.6 | 13.2 | 0.84 | 0.06 |
|     Negative | 69.5 | 13.2 | 0.75 | 0.84 |
| Hypothesis tests | $F = 73.9$ | $df = (1,423)$ | $F = 10.26$ | $df = (1,424)$ |
| | | $\boldsymbol{p < .001}$ | | $\boldsymbol{p < .001}$ |
| **Interaction Term** | Positive Mimicry | | Negative Mimicry | |
| | *eMM* | *SE* | *eMM* | *SE* |
| Valence*Veracity | - | - | - | - |
|     Negative Lie | 69.4 | 13.3 | 0.45 | 0.11 |
|     Negative Truth | 69.7 | 13.3 | 0.91 | 0.04 |
|     Positive Lie | 91.8 | 13.3 | 0.71 | 0.10 |
|     Positive Truth | 75.4 | 13.3 | 0.92 | 0.04 |
| Hypothesis test | $F = 21.16$ | $df = (1,423)$ | $F = 3.31$ | $df = (1,424)$ |
| | | $\boldsymbol{p < .001}$ | | $p = .07$ |
| **Random effects** | Positive Mimicry | | Negative Mimicry | |
| | | *SD* | | *SD* |
| Respondent | | 0 | | 0.52 |
| Speaker | | 26.27 | | 0.78 |
| Residual | | 19.11 | | - |

*Note.* High mean values in positive mimicry indicate a greater disparity in mimicry; low values indicate a better match in mimicry. Probability values in negative mimicry indicate the proportion of the group estimated to display no mimicry.

**Figure 2**

*Bar Chart Displaying Estimated Marginal Means (EMMs) of Mimicry of Positive Emotions for Different Combinations of Veracity and Valence.*
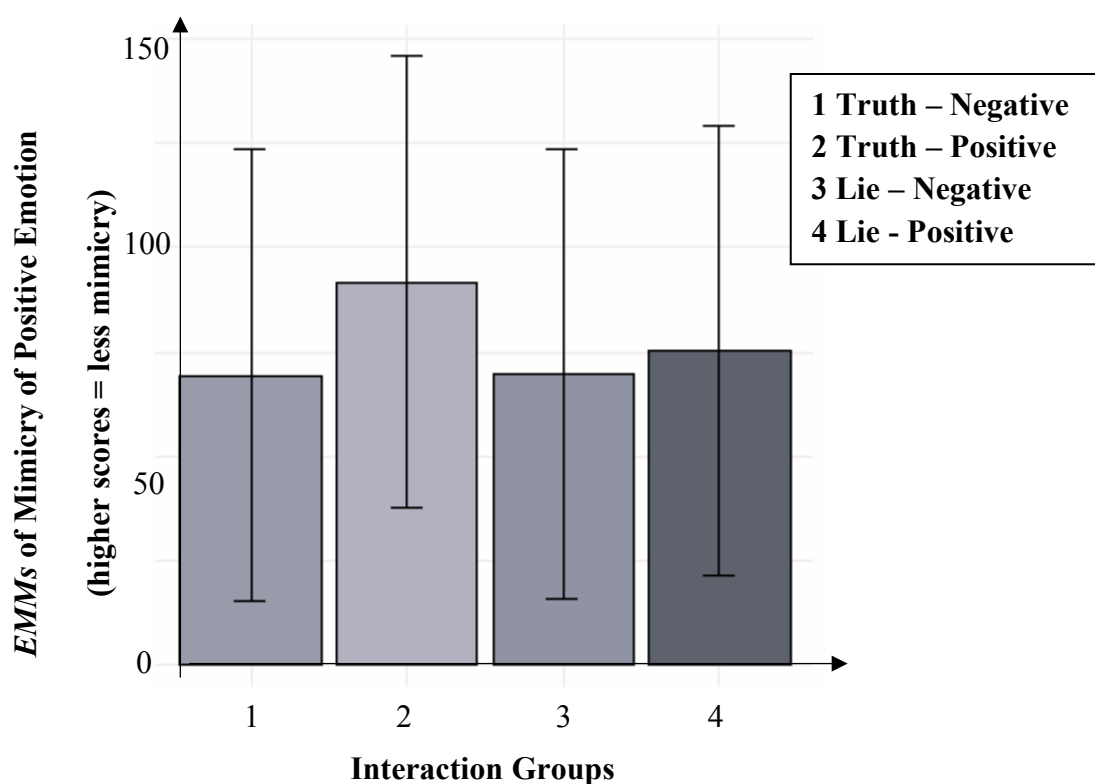


**Explorative Analysis**

Furthermore, as most outcomes were contrary to expectations, explorative analyses were performed to gain deeper insight into the relationships between variables. Since scores of 0 could indicate both perfect mimicry and no emotion that exceeded the threshold, it is possible that

scores indicating low mimicry actually capture the extent to which participants expressed emotion. Therefore, a sensitivity analysis of the mimicry of negative emotions was planned, but the analysis failed to converge after excluding all zeros.

To determine if manipulations of veracity and valence affected participants' facial expressions, their positive and negative facial emotions were solely investigated in further detail. Two mixed-effects models, with the same fixed and random effects as in the models of mimicry, were performed to explore the effect of the predictor variables on the expression of positive and negative emotions in respondents. Relevant outcomes can be found in Appendix D. Neither the main nor interaction effects were significant, indicating that valence, veracity, and their interaction did not affect the facial expressions captured by the participants.

Finally, to investigate whether experimental manipulations affected the perceived valence of the videos, another mixed effects model was performed with perceived valence as the outcome variable was performed. Both main effects were significant, meaning that people perceived the videos that contained lies more positively than videos where the truth was told, but only with a small difference. Additionally, positive videos were perceived more positively, regardless of their veracity, as displayed in Table 3. Simple effects analyses following the significant interaction effect showed significant differences between all group levels ($p < .01$). Positive truths were considered the most positive, followed by positive lies, then negative lies and finally, negative truths.

**Table 3**

*Outcomes of the Mixed Effects Model for Perceived Valence.*

| Independent Variables | Dependent Variable | |
| --- | --- | --- |
| **Fixed effects** | | |
| | Perceived Valence | |
| | *M* | *SE* |
| Veracity | - | - |
| Truth | 3.88 | 0.11 |
| Lie | 3.92 | 0.11 |
| Hypothesis tests | *F* = 8.01 | *df* = (1,399) |
| | | ***p* = 0.004** |
| | Perceived Valence | |
| | *M* | *SE* |
| Valence | - | - |
| Positive | 4.43 | 0.11 |
| Negative | 3.37 | 0.11 |
| Hypothesis tests | *F* = 11.61 | *df* = (1,399) |
| | | ***p* < .001** |
| **Interaction Term** | Perceived Valence | |
| | *M* | *SE* |
| Valence*Veracity | - | - |
| Negative Lie | 3.62 | 0.14 |
| Negative Truth | 3.12 | 0.14 |
| Positive Lie | 4.22 | 0.14 |
| Positive Truth | 4.64 | 0.14 |
| Hypothesis test | *F* = 13.46 | *df* = (1,399) |
| | | ***p* < .001** |
| **Random effects** | Perceived Valence | |
| | | *SD* |
| Respondent | | 0.28 |
| Speaker | | 0.04 |
| Residual | | 1.30 |

*p < .05, p < **0.01**, p < **0.001**.*
*Note.* Perceived Valence ranged from 1 (extremely negative) to 6 (extremely positive).

## **Discussion**

This study aimed to investigate to what extent watching positive or negative lies

compared to truths is associated with differing levels of facial mimicry. It was anticipated that

there would be more mimicry for positive emotions and truths, a relationship between veracity judgments and mimicry, and a positive relationship between the evaluation of speakers and mimicry scores. Key findings for mimicry are that, overall, negative stories elicited more mimicry than positive stories. There was more mimicry of negative emotions for lies than in truths. Further, veracity alone did not affect mimicry of positive emotions, but the interaction between valence and veracity did. Additionally, more mimicry of negative emotions led to a lower direct deception belief but a higher indirect deception belief. Furthermore, valence, veracity and their interaction did not affect emotional expression but did affect the perceived valence of the videos, with lies and positive valence perceived more positively. Perceived valence and emotional expression, however, did not show an association with each other. Additional findings were that a more positive impression of the speaker led to a more positive perceived valence. Most of the findings contrast what was supposed and give new insights into the relationship of valence, veracity and mimicry and their surrounding influences.

**Affiliation and Emotional Mimicry**

Our evaluation of someone as positive or negative affects our mimicry of their emotion and is influenced by more than just the desire to affiliate with that person. Results suggest that evaluating someone as positive or negative might elicit opposing mimicry of emotions in a way that if we like someone, we are more likely to mimic their negative emotions; if we dislike someone, we mimic their positive emotions more. Additionally, negatively valenced stories and lies were mimicked more overall. Therefore, these two mechanisms must be evaluated.

Since the average impression of the speakers was relatively negative to neutral, mimicking the positive emotions of a person perceived as negative might be due to trying to be polite rather than trying to affiliate. Therefore, participants might not have felt close to the

people in the videos and did not desire to build a relationship with them; rather, they showed empathy to a stranger. With that, showing understanding and politeness rather than being highly affiliated with the people in the videos can be derived from a more prosocial orientation some people have that affects mimicry (van Baaren et al., 2004). In addition to that, the desire to appear polite might have inhibited the participants from expressing negative emotions at some points. Knyazev et al. (2012) support this by arguing that expressing positive emotions leads people to focus less on the conscious perception of angry faces, supposing that emotional expression takes up cognitive capacities to perceive other types of expressions, aligning with the study's results.

Moreover, increased mimicry of negative emotions in people evaluated as more positive speaks for increased emotional involvement within the social context (Duffy & Chartrand, 2015), considering the emotions of their counterparts more genuinely. This also aligns with the role of empathy when mimicking others (Hess & Fischer, 2014). Therefore, affiliation with persons might be expressed by mimicking the negative emotions rather than the positive ones due to being more emotionally involved and being more empathic towards them and not expressing rather superficial cues. Overall, mimicry based on valence and veracity is suggested to be influenced by a combination of affiliation goals, prosocial orientation, and empathetic responses depending on the evaluation of the other person.

**Receiver and Emotional Expression**

Findings show that while valence and veracity did not affect the display of emotions in receivers, they did affect the perception of valence of the videos. Overall, participants displayed little emotion, possibly because of the lack of a relationship between the internal perception of valence and the facial emotions displayed. As shown in Table 1, their relationship was

essentially zero, raising the question of whether facial expression analysis is a valid measure of felt emotion.

Firstly, social desirability biases can occur in self-reported measures indicating valence as more positive or negative than experienced (Nederhof, 1985). However, they can also influence facial expressions in ways that presented emotions are for social signals, representing a desired outward expression and not only actual emotions felt. Therefore, what is felt internally might not always naturally align with what is expressed outwardly. An emotional outward reaction towards certain stimuli can be unconsciously elicited without access to active reflection on why or how the person feels and thinks about that stimulus (Winkielman & Berridge, 2004). This indicates that people in the study possibly have shown expressions before categorising what they perceived and how they felt towards this. This could also be influenced by indicating their perception after completing a lengthy veracity questionnaire. More time passed between the expression and the categorisation, potentially leading to more reflection on what was felt than the immediate unconscious response.

Further, behavioural measures are highly context-dependent. This study's lack of a strong social context or relationship to the persons in the videos could have contributed to the participants' low overall emotional expression scores but higher scores displayed by video stimuli. Social contexts incorporate that people tend to show emotional expressions only when there is a social role or purpose, such as conforming with others (Chapman & Chapman, 1974; Hofmann et al., 2015). Therefore, as participants did not engage in a natural conversation and were not actively watched by others during the study, there was a lack of a social role reinforcing outward expressions. This leads to the conclusion that facial expressions do not effectively

measure genuine emotion when only watching videos and that inner perception and outward
expression often do not align.

**The Relationship between Perceived Valence and actual Valence and Veracity**

The interaction between valence and veracity revealed interesting effects on the
perception of valence. Generally, negative lies were perceived more positively than negative
truths, but positive truths were perceived more positively than negative lies. These relationships
raise questions about whether truths are more emotionally engaging for people or contain more
emotive content. However, why would negative lies then be perceived as more positive than
negative truths? Possibly, negative lies are framed more positively than negative truths told to be
more convincing. Self-presentation goals could influence this as liars mostly still want to appear
authentic and likeable (Mun & Kim, 2021). However, Morris and DePaulo (2004) argued that
liars are sometimes more unpleasant and complaining and that truths are often more detailed and
emotionally nuanced. This speaks against a more positive presentation of negative lies than
truths and still leaves questions about why the relationship was influenced this way. A deeper
focus on the perception of valence through, for example, indirect measures is needed to
investigate the effects of veracity and valence further and understand this relationship.

**The Relationship between Perceptions of Veracity and the Measures of Emotion and
Mimicry**

Interestingly, one finding was that the more a person believed to be deceived indirectly,
the more mimicry of negative emotions was displayed. This corresponds with the main effect of
veracity, with lies eliciting more mimicry of negative emotions. This correspondence suggests
that more mimicry of negative emotions might indicate a deception belief and that indirect
measures might reveal that genuine emotions are unconscious (Weiher et al., 2023). Notably, the

higher someone believed to be deceived directly, the less they believed to be deceived indirectly, and both showed different directions of mimicry. These are either indications of issues with the validity of one of the measures or could show that different cognitive processes were used when responding to the questions. This implies that unconscious, higher deception beliefs might be displayed through more mimicry of negative emotions, and conscious ones might be displayed through less mimicry with more awareness of facial expressions.

However, effect sizes were quite small and can be misleading as there often is greater overlap between groups not directly shown by outcome values (Satchell, 2023). This should be considered when interpreting the correlations. Moreover, the small directions of the correlations and the lack of a relationship between the mimicry of positive emotions and veracity judgment propose that mimicry might not have measured deception belief as supposed. Emotional and nonverbal cues to deception have been in discussion for a considerable time, and their reliability is questioned throughout (Vrij, 2019). Additionally, some people might, for example, smile because they are genuinely happy and others because they want to cover up discomfort. This shows that some expressions might be ambiguous in their purpose, leading to potential misinterpretation if no further explanation of intentions is provided (Frank et al., 1993). Therefore, although there was little relationship between veracity judgment and mimicry of negative emotions, emotional expressions and mimicry might not be reliable enough to leak cues to deception when other contexts are not accounted for.

**Strengths and Limitations**

This study offers valuable insights through a novel approach. It includes the perceiver as the main object to understand underlying patterns and behaviour associated with deception and

highlights the importance of caution when interpreting mimicry and facial emotions in connection to deception using automated measures.

Firstly, this study was limited by utilising video stimuli, where social context and relationships were rather neutral. Conclusions about affiliation goals, social context, and mimicry by Hess and Fischer (2014) and Bourgois and Hess (2008) were also based on video stimuli. However, the relationship between participants and video stimuli was manipulated by providing background information and scenario descriptions that framed the relationship. These differences likely influenced the results and display of mimicry.

Not only was no relationship manipulated, but not talking to a human in real life and only watching someone on screen could have disrupted affiliation goals. This is also supported by a relatively low average rating of the speakers, which was between somewhat negative and neutral. Connecting all results, the lack of a social context and emotional involvement might have influenced the incongruence in perceived valence and displayed valence, leading to outcomes for mimicry that were not expected and possibly accounting for some of the small effect sizes. Therefore, when conducting such experiments, it is essential that the extent of the artificial context is considered and kept to a minimum.

Additionally, the software is not ideal for working with delta scores in mimicry. There is no differentiation between actual perfect mimicry and no emotions displayed by both sides, as zero scores indicate both. No mimicry versus perfect mimicry is a detrimental difference that was hard to distinguish with this issue, impacting results and leading to false conclusions. For example, one could derive that there has been perfect mimicry even though there was none at all. Overall, we might falsely conclude that people express more mimicry of negative emotions, while it is possible that people just displayed more positive emotions than negative ones.

However, whether emotional expression differed based on veracity and valence was checked to account for this, but no effect was found.

## Conclusion

This study's results indicated that mimicry might be more complex than thought and dependent on other contextual factors. Therefore, desired affiliation and social contexts should be investigated further and directly manipulated to reveal whether people would show more expression and in what concrete contexts politeness plays a role. Furthermore, shifting the focus to the perceiver of lies and investigating the effects of valence has yielded new insights into the relationship between multiple conditions, such as perceived valence and actual facial emotions. Differences in the mimicry of positive and negative emotions show that, for example, the interaction of valence and veracity only affected the mimicry of positive emotion, and veracity conditions alone did not. This leads to recommending further research to explore the role of the perceiver and their expressions more deeply in varying social conditions. Facial Expression Analysis software proved to work efficiently in capturing facial emotions. However, it showed some unclarities when working with mimicry scores, advising that scores should be handled and interpreted cautiously because there is a risk of inferring perfect mimicry even when no emotions are displayed. Consequently, using mimicry as an indicator of deception or genuine emotion might not be accurate in an artificial context. This study highlights the need for caution in over-relying on theory, classifying people as deceptive, and acknowledging the potential risks involved when using automated measures.

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## Appendix A: Video Stimuli Chosen

People chosen from the Miami University deception database: WF010, WF011, WM010, WM011.

## Appendix B: Questionnaires, Informed Consent and Debrief

### Appendix B1: Preconceived Ideas about Lying

PRI_1  I believe that people who lie avoid eye contact.

PRI_2 I believe that people who lie keep their hands still.

PRI_3 I believe that people who lie fidget more with their fingers.

PRI_4 I believe that people who lie look in many directions and to a lesser extent at the conversational partner.

PRI_5 I believe that people who lie blink more than they should naturally do.

PRI_6 People who lie sit in general more still.

PRI_7 I believe that people who lie use more illustrators (hand gestures) that accompany speech.

PRI_8 I believe that people who lie stare you more continuously in the eye.

PRI_9 I believe that people who lie move their feet and legs more than someone who tells the truth.

- Strongly Disagree  (1)
- Disagree  (2)
- Somewhat Disagree   (3)
- Neutral  (4)
- Somewhat Agree  (5)
- Agree   (6)
- Strongly Agree  (7)

### Appendix B2: Veracity Judgment Questionnaire

Please indicate on a scale from 1-6 how much you agree with the statements made below. 1 equals completely disagree and 7 equals completely agree.

DVJ = Direct Veracity Judgment

IVJ = Indirect Veracity Judgment

TH = Thinking hard

ID = Indifferent

VI = Verbal immediacy

CO = Cooperativeness

BC = Behavioural change

IVJ-ID: The person in the video seemed interested in what they were saying.

DVJ: I think the person in the video was lying.

IVJ-CO: The person in the video seemed willing to tell their story.

IVJ-TH: The person in the video seemed to find it easy to tell their story. (R)

IVJ-VI: The story the person told was personal.
IVJ-CO: The person in the video seemed hesitant to tell their story. (R)
IVJ-ID: The person in the video seemed uninterested in what they were saying. (R)
IVJ-VI: The person in the video seemed to distance themselves from their story. (R)
DVJ: I think the person in the video told the truth. (R)
IVJ-BC: The behaviour of the person was consistent over a while.
IVJ-TH: The person seemed to be thinking hard in what they were saying.
IVJ-BC: The person in the video changed their behaviour after a while. (R)

**Appendix B3: Informed Consent**
Welcome!

You are invited to participate in this study about deception detection! The project is conducted by Hannah Förster (BSc Psychology student at the University of Twente) and supervised by Dr. Steven Watson (Section of Psychology of Conflict, Risk and Safety, University of Twente) and Peter Slijkhuis. The study is approved by the Ethics Committee of the Faculty of Behavioural, Management and Social Sciences at the University of Twente.

Please take time to read the following information carefully before deciding whether or not to participate; it is essential for you to understand what participation in the study will involve.

Who can take part?
We are looking for adults who are at least 18 years old. Your English language skills must be sufficient to understand instructions, the videos you will watch and answer the questionnaires. Participation is entirely voluntary, and only anonymised data is analysed or represented.

What is involved?
If you decide to participate, you are asked to watch eight videos using a desktop computer. Before watching the videos, you are asked to complete a short questionnaire about your preconceived ideas about lying.  After each video, you are asked to fill in a short questionnaire about the videos. Instructions for completing the questionnaires are provided. You can stop participating at any point in the study without giving any reason.

The videos will show people talking about people they are in closer relationships with, such as a partner or a friend. The questionnaire asks you to decide if the people in the video were telling the truth, as well as what you thought about them and their story more generally. The answers to the questionnaires and your upper body, including your face, will be recorded during the study. Therefore, we ask you to keep your hands on the desk.

What happens with the data?

All data collected during the study will be kept strictly confidential. That is, your questionnaire responses cannot and will not be traced to your person, and no identifying information will appear in any documents or in the final report. We ask you to answer as honestly as possible. The videos will be potentially identifiable; however these will only be retained for as long as is necessary to verify the results of the study. Only anonymised data is retained for long-term storage or shared beyond the research team.

This anonymised data is stored for at least 10 years in accordance with BMS data policy for the auditing and verifiability of research data. In accordance with the principles of open science, this anonymised data may be shared with the research community, but only data that cannot identify you as an individual will be shared.

Your data will be used as part of a BSc thesis but may also be used as part of a future research article or academic conference presentation.

Before you can start with the survey, we ask you to read the information on the next page carefully and if you agree, click 'YES' to provide your consent to take part in the research.

Thank you in advance for your participation! If you have any questions about this study, please contact the researcher.

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The University of Twente ethics committee
decaan-bms@utwente.nl

Informed Consent

By clicking YES below, I agree to the following:

I understand that my participation is voluntary. I also understand that I have the right to withdraw my consent at any time without giving a reason if I experience any discomfort or distress.

Furthermore, the following points are clear to me:
All data that the researcher collects are treated with caution. The researcher will record the answers to the questionnaires and my upper body, including my face. I understand that only data which does not allow identification of me individually will be retained for long term storage or shared beyond the research team.

I understand the purpose of the current study. I understand that after completion of the study I will receive a debriefing.

I agree to keep the procedures and explanation of this study to myself and will not pass this information on to others because this might negatively influence the study results.

I agree to participate in the study:
- Yes, I will consent to the above stated information stated above.
- No, I will not consent and do not want to continue the study.

**Appendix B4: Demographic Questions**

Demographic questions:
1. What is your age?
    [Text entry]
2. What is your gender?
    - Male
    - Female
    - Self-described [Text entry]
3. What is your nationality?
    - Dutch
    - German
    - Other [Text entry]
4. What is the highest level of education you have completed?
    - Secondary school
    - High school
    - University Bachelor
    - University Master or higher
    - Other [Text entry]

**Appendix B5: Debrief**

Thank you for participating in our study: Automatic Monitoring of Facial Emotions to Measure Deception. Your participation is greatly appreciated, and we would like to provide you with some information about the study now that it has concluded.

This study aimed to get insight into whether it is possible to detecting deception by monitoring and analysing the receiver's of truthful and deceptive messages facial expressions. Research indicates that we might unconsciously mimic the emotions expressed in the liar when watching that person. We wanted to test that idea, and also to determine if this effect might differ depending on whether the truths and lies told were positive or negative.

During the study, you were asked to watch eight videos, four of which have been lies and four truthful statements. Additionally, the lies varied in how positive vs negative they were in order to see whether this affects the emotions detected in the participant's facial expressions. After each video, you filled out questionnaires that assess to what extent you thought the statements to be truthful or not, and what you thought about the descriptions in the videos. This is needed to compare whether traditional methods of assessing deception, asking direct and indirect questions about it, with our automatic mimicry measure.

As a reminder, your responses and any data collected during the study will be kept confidential. Your data will only be used for research purposes and identifiable data, such as the facial recordings, will be destroyed as soon as possible after data analysis and after any analyses required for any publication have been completed. Your anonymised data will be stored for at least 10 years in accordance with the BMS data retention policy. This rule is in place to ensure research is based on genuine data.

If you have any questions or concerns do feel free to ask about them now.
If you have any questions or concerns about the study once you leave the experiment, please do not hesitate to contact Hannah Förster at h.forster@student.utwente.nl.

Once again, we sincerely appreciate your participation in this study. Your contribution is invaluable to our research efforts.

Sincerely,
Hannah Förster
University of Twente.

**Appendix C: Assumption Checks**

**Appendix C1: Assumption checks of the mixed effects model of mimicry of positive emotions.**

**Figure 2**

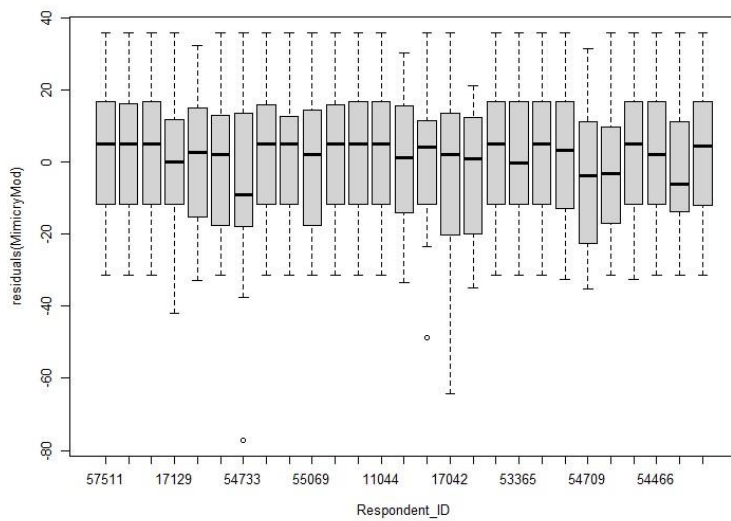*Visualisation of Residuals against Respondents.*



**Figure 3**
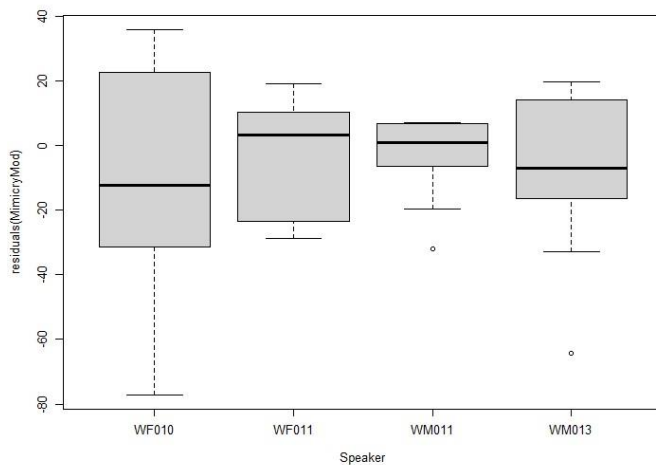
*Visualisation of Residuals against Speaker.*
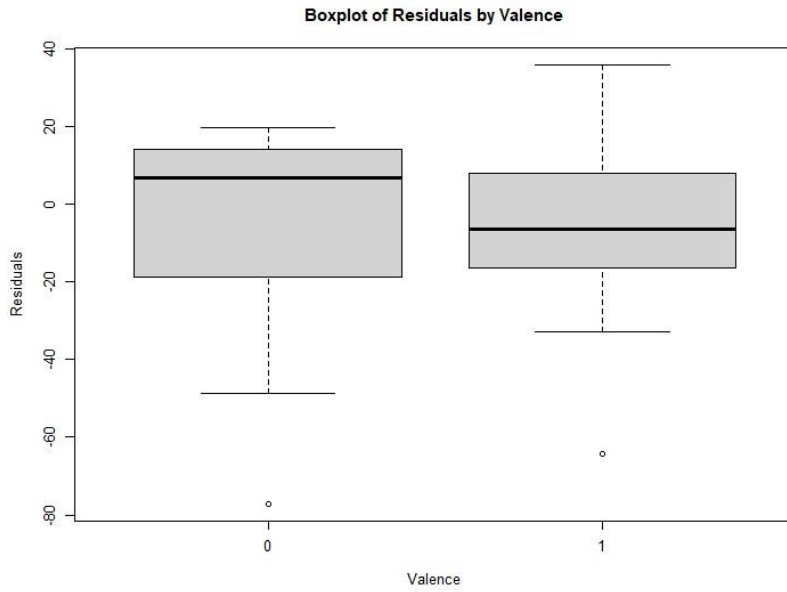
**Figure 4**

*Variance of Valence.*



Boxplot of Residuals by Valence

**Figure 5**

*Variance of Veracity.*



Boxplot of Residuals by Veracity
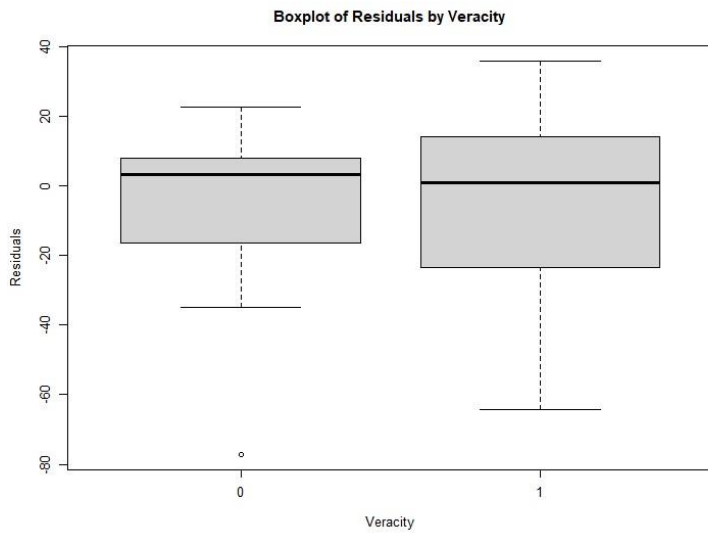
**Figure 6**

*Residuals against Fitted Values of the Model.*
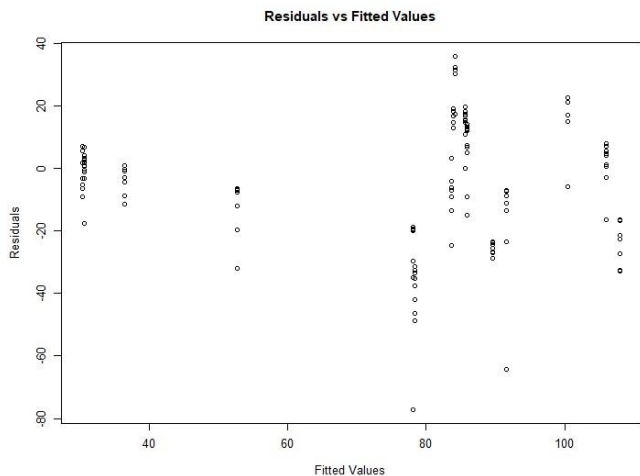


**Appendix C2: Assumption checks of the generalised linear model of mimicry of negative emotions.**

**Figure 7**

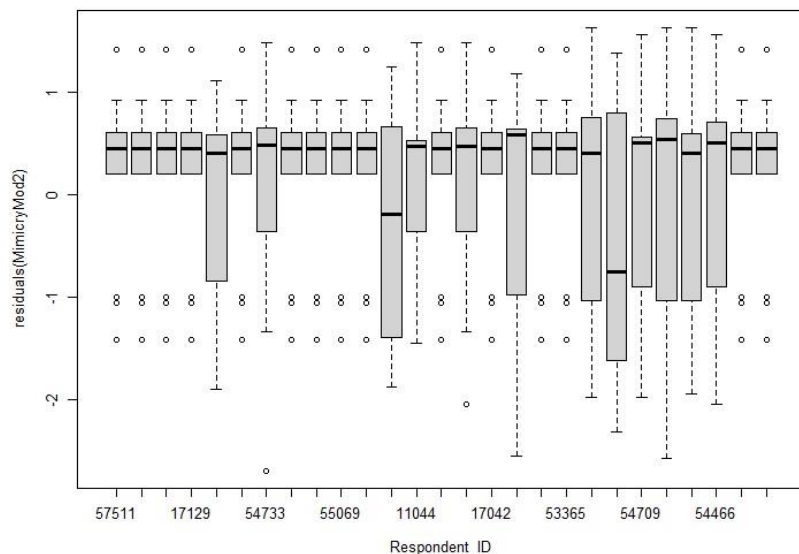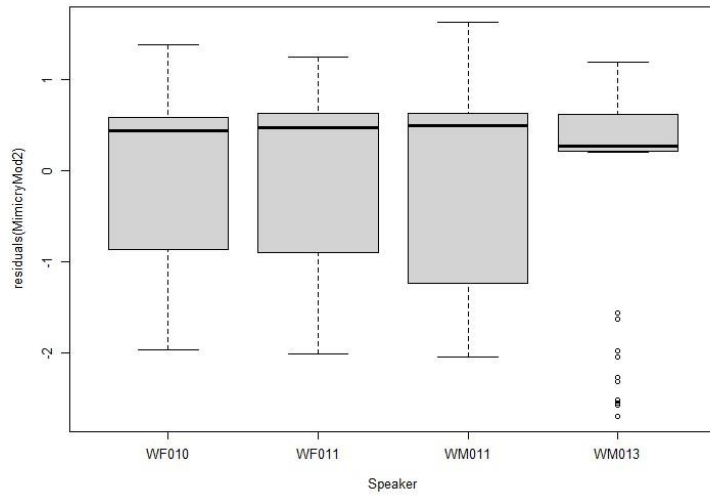*Visualisation of Residuals against Respondents.*

**Figure 8**

*Visualisation of Residuals against Speaker.*
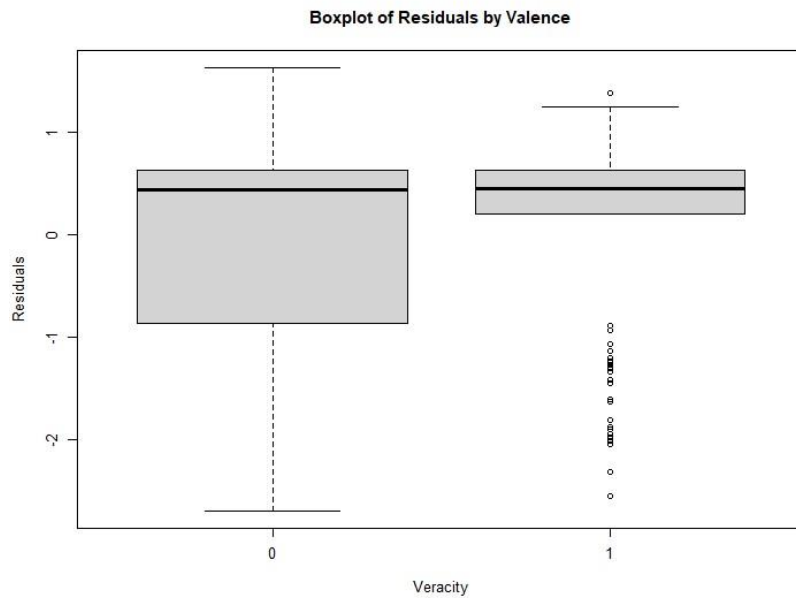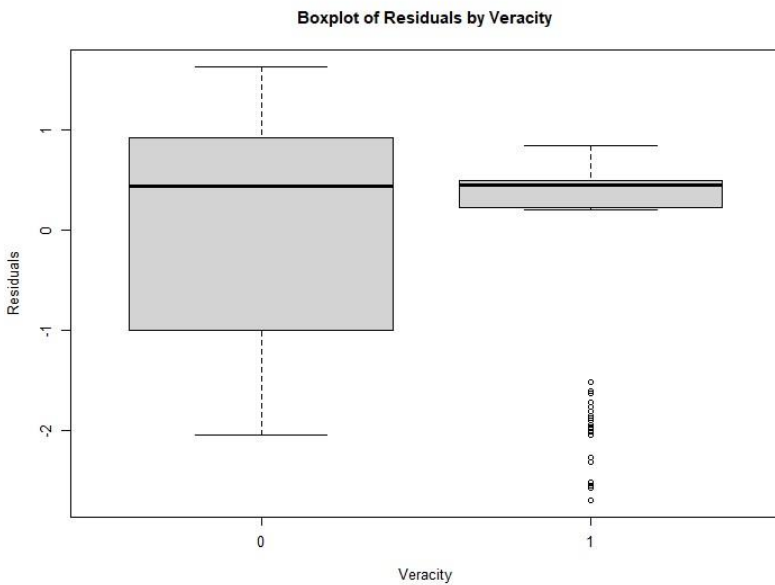


**Figure 9**

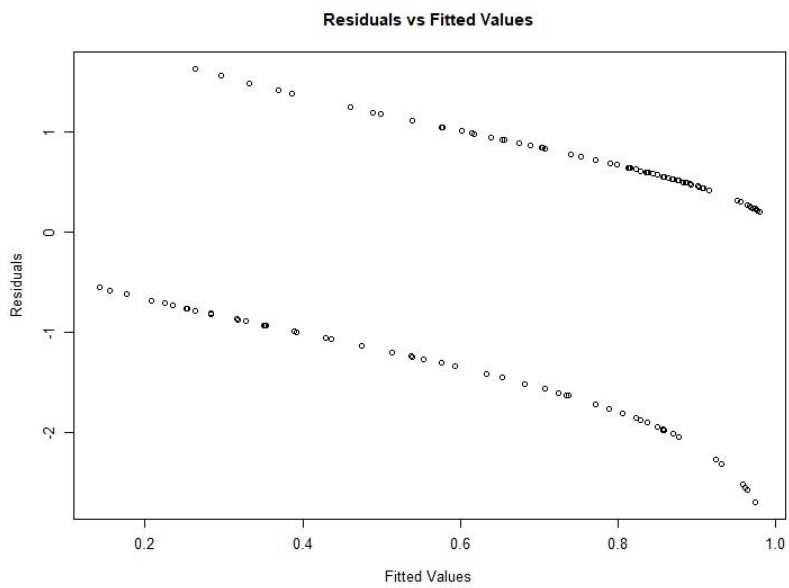*Variance of Valence.*

**Figure 10**

*Variance of Veracity.*



**Figure 11**

*Residuals against Fitted Values of the Model.*

# Appendix D: Statistical Outcomes of Explorative Analyses

## Table 4

*Main Outcomes of the Mixed Effects Models for Display of Positive Emotions and Negative*

*Emotions.*

| Independent Variables | Dependent Variables | | | |
|---|---|---|---|---|
| **Fixed effects** | | | | |
| | Positive Emotion | | Negative Emotion | |
| | *M* | *SE* | *M* | *SE* |
| Veracity | - | - | - | - |
| Truth | 2.38 | 0.56 | 0.78 | 0.38 |
| Lie | 1.85 | 0.56 | 0.60 | 0.38 |
| Hypothesis tests | $F = 0.78$ | $df = (1,402)$ | $F = 1.53$ | $df = (1,399)$ |
| | | $p = .38$ | | $p = .22$ |
| | Positive Emotion | | Negative Emotion | |
| | *M* | *SE* | *M* | *SE* |
| Valence | - | - | - | - |
| Positive | 1.75 | 0.56 | 0.71 | 0.38 |
| Negative | 2.48 | 0.56 | 0.67 | 0.38 |
| Hypothesis tests | $F = 1.29$ | $df = (1,402)$ | $F = 0.88$ | $df = (1,399)$ |
| | | $p = .26$ | | $p = 0.35$ |
| **Interaction Term** | Positive Emotion | | Negative Emotion | |
| | *eMM* | *SE* | *eMM* | *SE* |
| Valence*Veracity | - | - | - | - |
| Negative Truth | 2.13 | 0.68 | 0.80 | 0.44 |
| Negative Lie | 2.82 | 0.68 | 0.40 | 0.44 |
| Positive Truth | 1.56 | 0.68 | 0.63 | 0.44 |
| Positive Lie | 1,94 | 0.68 | 0.93 | 0.44 |
| Hypothesis test | $F = 0.08$ | $df = (1,402)$ | $F = 1.35$ | $df = (1,399)$ |
| | | $p = .78$ | | $p = .25$ |
| **Random effects** | Positive Emotion | | Negative Emotion | |
| | | *SD* | | *SD* |
| Respondent | | 4.55 | | 1.17 |
| Speaker | | 0.00 | | 0.47 |

| | 32.00 | 3.12 |