Are You Lying to Me? Exploring Children's Nonverbal Cues to Deception

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Abstract

The present study investigates how easily it can be detected whether a child is being truthful or not, and explores the cue validity of a child's body movement for such type of classification. To achieve this, we introduce a combination of methods, in particular a perception test, and an automated body movement analysis. Film fragments from truthful and deceptive children were shown to human judges who were given the task to decide whether the recorded child was being truthful or not. Results reveal that judges are able to reliably and accurately distinguish truthful clips from lying clips. The automated movement analysis revealed a positive correlation between the amount of movement in a child and the perception of lies, i.e., the more movement the children exhibited during a clip, the higher the chance that the clip was perceived as a lie.

Keywords: Lying; Deception; Children; Nonverbal Cues; Body Movement; Automatic Analysis.

Introduction

A question which has intrigued many generations of researchers is whether and how one is able to detect if a conversation partner is being truthful about the things he or she is claiming, or not. Apart from criminal and juridical reasons, this question has been deemed relevant for educational and developmental purposes as well. Accordingly, this has led to a series of studies into child-specific aspects of deceptive behavior (Fu et al., 2012; Ruffman et al., 2012; Talwar &Crossman, 2011; Talwar & Lee, 2002a, 2002b). Obviously, one could think of many situations in which parents, caregivers, or teachers would find it useful to know whether or not a specific child is trying to deceive them, even when these may mostly relate to innocent issues like a broken window, a stolen cookie or a fight with another child. In particular, there has been a specific interest in nonverbal features (such as specific facial expressions or eye gaze patterns) that children could possibly display when they are telling a lie. However, as we will show below, in a review of the literature, the evidence regarding the usefulness of such nonverbal features as markers of deceptive behavior is quite inconclusive.

The variability in reported results could partly be due to (1) the kinds of features that have been investigated in terms of their cue value and (2) the techniques that have been used to detect such features. Moreover, it would also seem important that the lies that are investigated are natural and spontaneous, and in that way representative of the behaviour children exhibit in their normal social contexts, which would render acted versions of lies less suitable for research purposes. To introduce our own approach to detecting nonverbal cues in children's expressions, we first describe previous studies into deceptive behavior of children, then review previous findings of nonverbal correlates of lying behavior and then say a few words about methods to (automatically) detect lies. We then embark on a description of our own study, which consists of a specific elicitation paradigm, a perception study, and a variety of (automated) detection methods.

Children's Lying Behaviour

Previous research (Lewis, Stanger, & Sullivan, 1989; Talwar & Lee, 2002b) suggests that children are quite good manipulators of their nonverbal behavior when lying, which makes the discrimination between truth-tellers and lie-tellers very difficult to accomplish. Most studies report that children's lies can be detected around chance level, comparable to what has been claimed for adults (Edelstein, Luten, Ekman, & Goodman, 2006; Bond & DePaulo, 2006).

There is evidence that children start lying from a very young age as early as 2½ years old (Newton, Reddy, & Bull, 2000), and according to Talwar & Lee (2002b) lie-tellers between 3 and 7 years old are almost indistinguishable from truth-tellers. Nevertheless, some studies suggest that lie-tellers tend to exhibit slightly more positive nonverbal behaviours, such as smiles, relaxed and confident facial expressions, and a positive tone of voice, which is also congruent with the findings from Lewis, Stranger & Sullivan (1989). In addition, earlier work also suggests (e.g. Feldman, 1979) that children have a poor control on their nonverbal behavior.

The extent to which children display nonverbal cues could be related to the kind of lie and to the circumstances under which these are told. In earlier work (Swerts, 2012; Swerts, van Doorenmalen, & Verhoofstad, 2013), it was reported that children tend to leak more cues to deception when they are more aware of their deceptive attempt: for example, children's second attempts to lie (after having been told to repeat a previous lie) revealed more nonverbal cues in their facial expressions when compared to their first attempts. These findings, according to the authors, might be explained by the ironic effect of lying which states that lying becomes more difficult and most likely less successful, if a person becomes more conscious about his or her behaviour when trying to intentionally produce a deceiving message.

Nonverbal Cues to Lying

Even though lie detection appears to be a challenging task to human judges, many people share the intuition that there are specific nonverbal cues that may reveal whether a person is truthful or not (Bond, 2012).

Most of the literature suggests that possible cues to deception are often in the face. It has been claimed that one can sometimes distinguish truth-tellers from deceptive-tellers on the basis of particular micro-expressions, such as minor cues in the mouth or eye region (Ekman, 2009; Swerts et al., 2013). However, by their very nature, such micro-expressions are so subtle in nature, and last only a few milliseconds that they might escape a person's attention, so that deception detection tends to be a very difficult task.

Furthermore, Mann et al. (2013) argue that eye gaze can also be a cue for deception. According to this study, liars showed more eye contact deliberately than truth tellers, whereas gaze aversion did not differ between truth tellers and lie-tellers. Moreover, others (DePaulo et al., 2003) report that deception detection can be based in specific areas of the mouth, such as: pressed lips when reporting a lie, and certain types and frequencies of smiles.

In addition, a number of researchers suggested looking at body movement as a source for lying detection but there are some contradictory statements about the usefulness of body movement. On the one hand, some literature states that when lying, people tend to constrain their movements, even though it is unclear whether these restrictions are related to strategic overcompensations (DePaulo, 1988), or to avoid deception leakage cues (Burgoon, 2005). In a similar vein, Eapen et al. (2010) measured the continuous body movement of people in spontaneous lying situations, and found that those who decided to lie showed significantly reduced bodily movement. On the other hand, using a dynamical systems perspective, Duran et al. (2013) report the existence of continuous fluctuations of movement in the upper face, and moderately in the arms during a deceptive circumstance, which can be discriminated by dynamical properties of less stability, but larger complexity. Although, these distinctions are presented in the upper face, this study failed to find a significant difference in the total amount of movement between a deceptive and truthful condition.

Lie Detection Methods

Given these alleged cues to deception, there have been several attempts in the literature to develop methods for deception detection, where most methods have tried to use information from the human face (Ekman, 2009; Swerts et al., 2013).

Many of these approaches are based on, the Facial Action Code System (FACS) (Ekman & Friesen, 1976), known as the reference method for detecting facial movement and expressions, which has also been applied for detecting facial cues to deception (ten Brinke, Porter, & Baker, 2012). As a manual method, FACS is very complex to apply since it demands trained coders, and is also very time consuming. Fortunately, due to technology development, currently automated measures are being used to help researchers to understand and detect lies more efficiently. For instance, the Computer Expression Recognition Toolbox (CERT) (Littlewort et al., 2011) based on FACS, is able to detect facial movements and microexpressions that can possibly be associated with nonverbal correlates of deception. In the future, such methods could be combined with what has been achieved via automated analysis of verbal cues (Benus et al., 2006) and gestures (Hillman, Vrij, & Mann, 2012) as potential sources for lying detection. Finally, several studies (Ding et al., 2013; Kozel et al., 2005) investigated whether deception detection could be achieved by measuring brain activity during lying. However, these methods are quite intrusive, and not suitable for all contexts, especially when dealing with specific types of data.

In sum, considerable work is currently being done on the development of efficient automated methods to detect deception, but there is still a tendency to discard the body as a source of possible nonverbal cues. However, automated movement analysis is starting to be used for this purpose as well (Duran et al., 2013; Eapen et al., 2010). The inconsistency regarding the relevance of certain cues to deception might be explained by the use of different detection methods. Therefore, a new holistic approach to look into nonverbal cues of deception is proposed below.

Data Collection

Paradigm for Eliciting Lies

In order to elicit deception in young participants, we used a child-friendly procedure, which naturally induces truthful and deceptive statements from children. Inspired by previous work (Talwar & Lee, 2002a, 2002b; Talwar & Crossman, 2011), we developed a specific game, "Guess what I have behind the back?" which was presented to a child participant as a game in which an adult person (experimenter) had to guess what kind of object (fruit or animal) the child participant was hiding behind its back. This was achieved by a series of 9 simple questions (is it a fruit or an animal? What is its color?, etc.) asked by the adult, and answered by the child. After the series of questions, the experimenter had to make a guess about what object the child was hiding. In the truthful condition, the child that hid the object replied to the questions about the object in a truthful way (truthful condition). In the two subsequent lying conditions, the child was encouraged to lie (by giving incorrect answers about the object, such as: saying that the object was orange when it was red) when answering the questions about the object. In order to achieve this, a confederate (another adult who was also present in the room) in between sessions prompted the child to lie in order to win the game and get a present as a reward. The arguments given by the confederate to elicit the lie were that the experimenter thought and said out loud that she was the best in this game. The confederate did this when the experimenter was absent, because she had to leave the room with an excuse (to pick up a phone call, or to pick up the next child that would play the game). The game was played twice in the deceptive condition, the only difference being that during the first lying condition the experimenter lost the game (after the final question) and guessed the object wrongly; while in the second lying condition, despite what the child described, the experimenter guessed the object correctly. The reason for having two lying conditions was inspired by previous results that children's second attempts of deceiving might reveal more nonverbal cues (Swerts et al., 2013). Each object (banana, apple, dog and a giraffe) was attributed to a specific box, so that the experimenter always knew what was inside the box (even when the child was not aware that the experimenter in fact had this knowledge).

Participants

Forty-two Portuguese children aged between 6 and 7 (M=6.38) years old enrolled in the 1st year of primary school participated. Two of the participants (a boy and girl) were removed from the sample because they refused to deceive the experimenter.

Procedure

Each game session lasted for about 30 minutes (depending on how wordy or fast a specific child was), and consisted of 5 distinctive moments: 1) Briefing, 2) Warming-up; 3) Truthful condition, 4) Lying conditions and 5) Debriefing. In the first phase (briefing), the experimenter explained the game to the children. In the warming-up, the experimenter played the game with the child, but in this case the roles were inverted: the experimenter picked an object and hid it behind her back. Then, the child had to ask questions about the object until the child was able to guess what the object was. After this training session, the actual experiment started (phase 3 and 4). First, the child played in the truthful condition, and then in the two lying conditions (see above). The session ended with a short debriefing in which a small reward was given. All the children enjoyed the game, and engaged easily (without any suspicion) on the lies.

Materials

The games were recorded in high definition (HD) color using an HD video camera. Only the child was recorded (frontal view), while the experimenter, who was positioned next to the camera, was not recorded. Children were standing upright (Figure 1), against a white wall, to assure that all body movements were captured during the game play. The sessions with the children lasted between 52 seconds and 2.30 minutes.

Figure 1: The figure displays three different children playing the game during the experiment. The recordings catch all body movements.

Perception Test

A perception test was set up in order to explore whether judges would be able to guess whether the recorded children were saying the truth or were lying to the experimenter, based on their nonverbal behavior. From the 40 children, fragments of 30 children were selected for the perception test. For each child, we selected its responses to two consecutive questions ("*is it a fruit or an animal?"and "what is the size of it?")* in the three elicitation conditions, leading to a total of 90 clips. Ten children were not included in the perception test because they took more than 20 seconds in replying to the above-mentioned questions. Finally, the clips (without sound) were presented in a randomized order to small groups, consisting of 2-3 participants.

Participants

Twenty undergraduate students, between 18 and 25 years old (M=22.2, 15 women and 5 men), were recruited from the online subject pool system from the School of Humanities of Tilburg University. Students participated for a course credit.

Procedure

Upon arrival in the lab, each group was informed about the aim of the perception test. Every participant also received a questionnaire for rating each clip. The questionnaire consisted of two simple questions– *1) Is this child lying? (yes/no)*; and *2).If you said "yes", where did you base your decision on? (feet/legs/shoulders/face/other, please specify).* When responding to the second question, multiple answers were allowed. The perception test was administered as a Keynote presentation on an iMac. The perception test consisted of two phases – the warming-up phase in which 3 test clips (different from the ones used in the actual experiment) were shown and the respective part of the questionnaire was completed. After this the actual perception test started, in which 90 clips were presented and the respective questionnaire was individually answered. After each clip, there was a gap of 10 to 15 seconds, which participants used to rate the clip. Each session was group-paced, and lasted between 30 to 40 minutes.

Results

The following results refer to the first question of the questionnaire – *Is this child lying? (yes/no).* For each clip, we first computed the percentage of times it had been classified as being deceptive by the judges. In an ideal situation with perfect classification results, this would give a response of 0 for clips of the truthful condition, and 100 for the two lying conditions. A one-sample t-test on these average scores revealed that they differed significantly from chance level (50%). In particular, the test showed that the scores were significantly below 50% for the truthful condition ($t(19)=-2.27$, $p= .05$), and above 50% for the two lying conditions(for the ly1, $t(19)=5.01$, $p=.05$; and for ly2 $t(19)=3.91$, $p=.05$).

In addition, a Repeated Measures Anova was conducted to compare the percentages of lie responses in each of the 3 conditions (Tc, Ly1 and Ly2). The analysis revealed a main effect of condition ($F(2,38)=38.804$, $p< .001$). Posthoc pairwise comparisons using the Bonferroni method showed that Ly1 (M=0.628, SD=0.114) and Ly2 (M=0.613, SD= 0,129) are significantly different from the Tc (M=0.430, SD=0.138, but not between themselves (Ly1 vs. Ly2). These results are depicted in Figure 2.

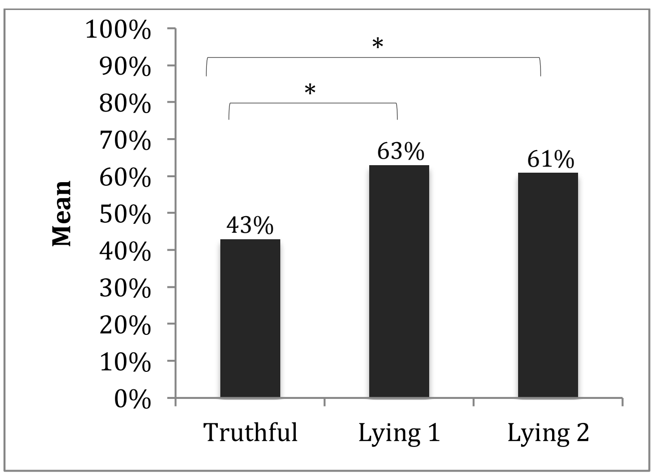

Figure 2: Frequency of lie responses for each of the 3 conditions (Tc, Ly1 and Ly2).

The goal of the second question- *If you said "yes", where did you base your decision on? (feet/legs/shoulders/face/ other, please specify),* was to understand which part(s) of the body judges thought to be meaningful for deciding whether a child is lying or not. The relative frequency for each of the reported areas of the body was calculated for all the lying clips and perceived lies (the ones that actually were truthful but were reported by the judge as a lie). Results show that participants report that the face (75.62%) is the best indicator of a lie, but feet (33.40%) and legs (30.35%) also seem to play a significant role, while shoulders (16.63%) and other (12.71%) have less significant impact. Note that these observations are based on an overall analysis of the child data, even though it is clear that there idiosyncratic differences between the participants (e.g. with some children being more expressive than others).

Analysis of Nonverbal Cues

When looking into the video sequences, and also based on what participants from the perception test reported, it seems that children tend to exhibit more nonverbal cues (more movement) in the deceptive conditions. In order to understand this phenomena and based on these empirical facts, three different types of analysis – automated movement analysis, correlation analysis and comparative analysis of the automated movement analysis- were performed.

Automated Movement Analysis

In order to estimate the amount of movement in the video sequences and to identify which areas of the body show those nonverbal cues, a frame-differencing method was used. In this automated method, the absolute changes of (grey-level) pixel values in all pairs of subsequent frames are recorded and averaged per pixel over the entire video sequence yielding for each video a heat map showing the averaged changes during the sequence (see Figure 3). A heat map is a visual representation in which numerical values, in this context average pixel changes, are represented by colours that are easily associated with an increasing quantity. In our case, the colours reflect increasing temperatures ranging from black/brown (low), via yellow (intermediate) to white (high).

The video dataset used in the perception test was submitted to an automated computer analysis. In total there were 30 participants, resulting in 3 x 30 videos matrix. Each triplet consists of one video per condition: truthful (Tc), first lying (Ly1), and second lying (Ly2). The videos were cropped in order to retain the central region showing the interviewed child. The original size of 1920 x 1080 pixels was reduced to th**e** central region of 801 x 1080 pixels. In three cases, small additional portions were removed due to movements caused by the experimenter and assistant.

In addition, to suppress spurious motions due to illumination compensation in the video camera, pixel changes were thresholded. The threshold value was set at a fixed value of 25 (absolute pixel-change range: 0-255). All change values smaller than the threshold were set to zero. A visual assessment of all heat maps revealed that this thresholding effectively removed the spurious motions for all videos.

The estimated total movement is expressed in the absolute pixel change, which is obtained by taking the average of the average pixel change maps. Figure 3 displays two heat maps of the average pixel changes obtained for a truthful (left) and a deceptive sequence (right). The maps show the outline of the body of a girl, brighter colours indicate larger changes during the video, and therefore more movement. The first image (left side) is a truthful sequence whereas the right side corresponds to a lying sequence. For the truthful condition, is possible to observe that the movements occur mainly on the upper part of the body and the head, while the lying video shows that the movements mainly occur on the head, face and feet. Her feet are brighter reflecting their frequent movements during the video sequence.

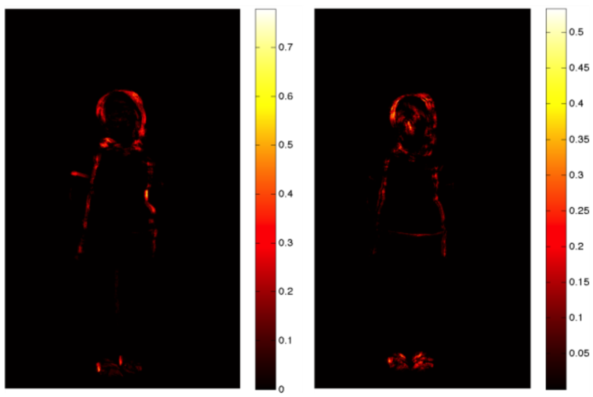

Figure 3: Illustration of the heat maps showing the outline of the body of a girl obtained for a truthful (left) and a deceptive (right) sequence. The unit of measure is the average pixel change, meaning that brighter colours indicate larger changes during the video, i.e., more movement.

Results

To assess the relation between the percentages of lie responses of the judges (from the perception test) in each of the 3 conditions and the amount of movement estimated by the frame-differencing method, a Pearson correlation analysis was performed. According to this analysis, there is a statistically significant correlation ($r=0.354$, $n=90$, $p < .001$) between these variables suggesting that the more movement there is in a clip, the more likely it is that a clip is perceived as lie.

Note that this first test did not specify whether a specific clip was in fact a lie or not. A Wilcoxon signed rank test of the automated movement results for each condition (Tc, Ly1 and Ly2) was performed to assess whether these movement scores could distinguish each of the conditions. The comparison between the truthful and the first lying condition shows that the pairwise differences are not statistical significant ($Z= -0.48$, $p= .61$, $r=209$). However, the results obtained by comparing the truthful and second deceptive conditions show a much clearer pattern, which suggests predominance of movement in the second deceptive condition, confirmed by the Wilcoxon signed rank test revealing the difference to be significant ($Z= -2{,}56$, $p= .01$, $r= 108$).

Discussion and Conclusion

Our research has led to a number of interesting results. First, it is noteworthy to point out that in our perception test, participants were able to distinguish truthful clips from lying clips above chance level, which contradicts most of the literature findings (Bond & Depaulo, 2006; Edelstein, Luten, Ekman, & Goodman, 2006). Maybe this could be partly due to the fact that the lies were very naturally elicited in a playful manner so that children were more expressive than in other social contexts.

In addition, our new method appeared to be very effective. The automated movement analysis revealed that there is a positive correlation between the amount of movement and the perception of lies, i.e., the more movement the children exhibited during a clip, the higher is the chance that the clip is perceived as a lie. This result contradicts the argument that people tend to constraint their movements, and show less body motion when lying, as reported by previous studies (Burgoon, 2005; DePaulo, 1988; Duran et al., 2013; Eapen et al., 2010). Moreover, the visualization through heat maps also point towards the same direction of the reported body regions in which the judges (from the perception test) think they base their decision, when deciding whether a clip is truth or a lie. The face (75.62%) is the most reported region but the feet (33.40%) and legs (30.35%) also seem to play a significant role. In future work, we will try out more focused automated analyses in order to o quantify the amount of movement in various body parts (face, feet and legs).

Lastly, the method suggests an interesting difference in nonverbal behavior between the children's first and second attempt to produce a lie. While the amount of movement appears not be distinct from the one in the truthful condition during the first attempt, there does appear to a difference during the second attempt. This effect appears to be in line with earlier finding (Swerts et al. 2013) that a child's awareness of the fact that it is producing a lie leads to the ironic fact that it becomes harder to hide nonverbal cues to deception: they tend to leak more cues because of the irony effect.

In conclusion, and according to these preliminary results, we can state that this new paradigm appears to elicit deception in an efficient way, and yields the emergence of nonverbal cues in the body. Contrary to what most of the research states, it seems that body movement is a good source for the detection of deception, though more elaborated analyses are needed. Accordingly, we plan to conduct a more systematic automated analysis of the body regions in which these cues seem to emerge, and a systematic analysis of facial expressions. Finally, note that the child participants in our study were Portuguese, whereas the judges were Dutch. In the future, it would be nice to explore whether there are any crosscultural differences in the expression and detection of deception.

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References

Benus, S., Enos, F., Hirschberg, J., Shriberg, E., International, S. R. I., & Park, M. (2006). Pauses in Deceptive Speech. In *ISCA 3rd International Conference on Speech Prosody* (pp. 2–5).

Bond, C. F., & Depaulo, B. M. (2006). Accuracy of Deception Judgements. *Personality and Social Psychology Review, 10*(3), 214–234.

Bond, G. D. (2012). Focus on basic cognitive mechanisms and strategies in deception research (and remand custody of "wizards" to Harry Potter movies). *Journal of Applied Research in Memory and Cognition, 1*(2), 128–130.

Burgoon, J. K. (2005). The Future of Motivated Deception and Its Detection. , 29, 1, 49-95. *Communication Yearbook.*.

DePaulo, Bella M. (1988). Nonverbal aspects of deception. *Journal of Nonverbal Behavior*, *12*(3), 153–161.

DePaulo, Bella M., Lindsay, J. J., Malone, B. E., Muhlenbruck, L., Charlton, K., & Cooper, H. (2003). Cues to deception. *Psychological Bulletin*, *129*(1), 74–118.

Ding, X. P., Gao, X., Fu, G., & Lee, K. (2013). Neural correlates of spontaneous deception: A functional near-infrared spectroscopy (fNIRS)study. *Neuropsychologia*, *51*(4), 704–712.

Duran, N. D., Dale, R., Kello, C. T., Street, C. N. H., & Richardson, D. C. (2013). Exploring the movement dynamics of deception. *Frontiers in psychology*, *4*, 140.

Eapen, N. M., Baron, S., Street, C. N. H., & Richardson, D. C. (2010). The Bodily Movements of Liars. In *33rd Annual conference of the Cognitive Science Society*.

Edelstein, R. S., Luten, T. L., Ekman, P., & Goodman, G. S. (2006). Detecting lies in children and adults. Law and Human Behavior, 30, 1, 1-10. *Law and Human Behavior, 30*(1), 1–10.

Ekman, P. (2009). Lie catching and micro expressions. In *In The philosophy of deception* (pp. 118–138).

Ekman, Paul ; Friesen, W. (1976). Measu ring Facial Movement *. *Environmental Psychology and Nonverbal Behaviour*, *1*(1), 56–75.

Feldman, R. S. (1979). Detection of Deception in Adults and Children via Facial Expressions. *Child development*, 350–355.

Fu, G., Evans, A. D., Xu, F., & Lee, K. (2012). Young children can tell strategic lies after committing a transgression. *Journal of experimental child psychology*, *113*(1), 147–58.

Hillman, J., Vrij, A., & Mann, S. (2012). Um … they were wearing …: The effect of deception on specific hand gestures. *Legal and Criminological Psychology*, *17*(2), 336–345.

Kozel, F. A., Johnson, K. a, Mu, Q., Grenesko, E. L., Laken, S. J., & George, M. S. (2005). Detecting deception using functional magnetic resonance imaging. *Biological psychiatry*, *58*(8), 605–13.

Lewis, M., Stanger, C., & Sullivan, M. W. (1989). Deception in 3-year-olds. *Developmental Psychology*, *25*(3), 439–443.

Littlewort, G., Whitehill, J., Wu, T., Fasel, I., Frank, M., Movellan, J., & Bartlett, M. (2011). The computer expression recognition toolbox (CERT). *Face and Gesture 2011*, 298–305.

Mann, S., Ewens, S., Shaw, D., Vrij, A., Leal, S., & Hillman, J. (2013). Lying Eyes: Why Liars Seek Deliberate Eye Contact. *Psychiatry, Psychology and Law, 20*(3), 452–461.

Newton, P., Reddy, V., & Bull, R. (2000). Children's everyday deception and performance on false-belief tasks. *British Journal of Developmental Psychology*, *18*(2), 297–

Popliger, M., Talwar, V., & Crossman, A. (2011). Predictors of children's prosocial lie-telling: Motivation, socialization variables, and moral understanding. *Journal of experimental child psychology*, *110*(3), 373–92.

Ruffman, T., Murray, J., Halberstadt, J., & Vater, T. (2012). Age-related differences in deception. *Psychology and aging*, *27*(3), 543–9.

Swerts, M. (2012). Let's lie together: Co-presence effects on children's deceptive skills. In *Proceedings of the EACL workshop on computational approaches to deception detection* (pp. 55–62). Avignon: E. Fitzpatrick, B. Bachenko, & T. Fornaciari (Eds.).

Swerts, M., van Doorenmalen, A., & Verhoofstad, L. (2013). Detecting cues to deception from children's facial expressions: On the effectiveness of two visual manipulation techniques. *Journal of Phonetics*, *41*(5), 359–368.

Talwar, V., & Crossman, A. (2011). From little white lies to filthy liars: the evolution of honesty and deception I. *The Paradox of Lies*. *Advances in Child Development and Behavior* (1st ed., Vol. 40, pp. 139–179). .

Talwar, V., & Lee, K. (2002a). Emergence of White-Lie Telling in Children Between 3 and 7 Years of Age. *Merrill-Palmer Quarterly*, *48*(2), 160–181.

Talwar, V., & Lee, K. (2002b). Development of lying to conceal a transgression: Children's control of expressive behaviour during verbal deception. *International Journal of Behavioral Development*, *26*(5), 436–444.

Ten Brinke, L., Porter, S., & Baker, A. (2012). Darwin the detective: Observable facial muscle contractions reveal emotional high-stakes lies. *Evolution and Human Behavior*, *33*(4), 411–416.