

Deception and lie detection in the courtroom:

The effect of defendants wearing medical face masks

Aldert Vrij (Department of Psychology, University of Portsmouth, UK,

aldert.vrij@port.ac.uk)¹

Maria Hartwig (Department of Psychology, John Jay College of Criminal Justice,

City University of New York & Graduate Center of CUNY,

mhartwig@jjay.cuny.edu)

Key words

Deception

Lie detection

Nonverbal behaviour

COVID-19

Signal Detection Theory

Jury decision making

¹ Correspondence concerning this article should be addressed to Aldert Vrij, Department of Psychology, University of Portsmouth, King Henry Building, King Henry 1 Street, PO1 2DY, Hants, United Kingdom. Email: aldert.vrij@port.ac.uk

Abstract

During the COVID-19 pandemic, defendants and witnesses (as well as the prosecution and defense counsel) may wear medical face masks to prevent the spread of the virus. Alternatively, courtroom proceedings may take place virtually. In this article we discuss how these deviations from normal procedures may affect jurors' lie detection ability and decision-making. Although research addressing this specific question does not exist, we are able to formulate an informed view based on the extensive deception literature. Since nonverbal signs to deception in the face and body are virtually absent, we conclude that medical face mask-wearing or virtual courtroom proceedings will not hamper jurors' lie detection abilities. If jurors can hear the speech well, they may become better at detecting deception if they will pay more attention to speech content, which may occur as a result of mask-wearing in the courtroom.

General audience summary

During the COVID-19 pandemic, defendants and witnesses (as well as the prosecution and defense counsel) may wear medical face masks to prevent the spread of the virus. Alternatively, courtroom proceedings may take place virtually. In this article we discuss how these deviations from normal procedures may affect jurors' lie detection ability and decision-making. Although research addressing this specific question does not exist, we are able to formulate an informed view based on the extensive deception literature. Since nonverbal signs to deception in the face and body are virtually absent, we conclude that medical face mask-wearing or virtual courtroom proceedings will not hamper jurors' lie detection abilities. If jurors can hear the speech well, they may become better at detecting deception if they will pay more attention to speech content, which may occur as a result of mask-wearing in the courtroom.

Deception and lie detection in the courtroom:**The effect of defendants wearing face masks**

In courtrooms, jurors are tasked with determining whether or not defendants are guilty of the charges against them, and, more generally, whether their testimonies are truthful or deceptive. As part of this process, jurors may rely on nonverbal behaviour, including paying attention to the testifying person's face (Vrij & Turgeon, 2018). During the COVID-19 pandemic, which is unfolding as we write this, defendants and witnesses (as well as the prosecution and defense counsel) may wear medical face masks to prevent the spread of the virus. What are the consequences of this for jurors in the courtroom? To what extent does the wearing of face masks impair (or improve) their ability to assess the truthfulness of the information they are exposed to? In the broadest terms, how do face masks in courtroom affect the dynamics of deception and its detection? This is the topic of the current paper.

Covering parts of the face when providing testimony raises many questions related to deception and its detection. For example, to what extent are there cues to deception that jurors are deprived of when wearing a mask? How do jurors perceive mask-wearing witnesses as opposed to non-masked ones? How are their lie judgments affected in general?

In this article, we address questions related to deception and face masking. One of our simple but fundamental conclusions is that the face does not appear to send signals to deception and that therefore jurors are unlikely to be hampered by defendants wearing face masks. They may even be helped if it means that they will pay attention to speech content when attempting to detect deception, providing they can hear the mask-wearers' speech well.

As an alternative to in-person court proceedings, virtual courtrooms have been proposed. Here, we review the available research that pertain to whether the dynamics of deception are altered by holding court proceedings virtually. Based on the available research, we conclude that virtual courtroom as an alternative to in-person court proceedings will not have a negative impact on jurors' lie detection ability either. We will also briefly discuss jury instructions regarding demeanour-based cues.

The questions we address in this article about the effects of mask wearing in courtrooms are all empirical questions worth examining. However, they have not been addressed in research. Actually, we are aware of only one experiment related to mask wearing in courtrooms (Leach et al., 2016) and discuss the findings of this experiment. We base our review on the general deception research literature instead. There are substantial differences between how deception research is typically carried out and the questions under investigation in this article. This raises the question to which extent the research findings can be generalized to courtroom settings. We believe that some differences are unlikely to have an effect, whereas the impact of other differences are unclear. We discuss here four differences: in stakes, preparation, interview setting and available background information.

The stakes, the positive consequences of being believed and negative consequences of being disbelieved, are considerable higher in courtroom settings than in deception research, which is overwhelmingly laboratory based. We think stakes will not affect our conclusions. A meta-analysis showed that stakes affect truth tellers' and lie tellers' responses in similar ways and, as a result, differences between truth tellers and lie tellers in lower stakes situations are comparable to those in higher stakes situations (Hartwig & Bond, 2014).

Although in many deception experiments lie tellers are given some opportunity to prepare themselves, preparation time in experiments is likely to be shorter than preparation time in real life. A meta-analysis into the ability to detect lies concluded that it may be harder to discriminate deceptive from truthful messages when the messages are planned versus unplanned (Bond & DePaulo, 2006).

In research interviews, respondents typically give a free narrative in response to an open-ended question, whereas in courtroom testimony respondents typically give brief answers to many directed questions (Denault et al., 2017). A rare experiment examining the effects of different interview styles showed that open-ended interviews resulted in more verbal cues to deceit than directed questioning but that accuracy in lie detection was unaffected by the type of questioning (Vrij et al., 2007).

In deception research, observers (people who make veracity assessments) typically are not given any background information about the statement the target person makes, such as independent evidence or statements given by other people about the same event. Observers can thus not compare what the target person says with background information and all they can rely upon is the demeanour of the target person and how s/he phrases the responses. If observers have background information, they often use it to make veracity assessments (Blair et al., 2010; Park et al., 2002), which makes paying attention to demeanour or how the responses are phrased less relevant.

Emphasis on nonverbal cues to deception

There is a pancultural belief that nonverbal behaviour reveals deception (Global Deception Research Team, 2006; Vrij, 2008). People, across populations and conditions, systematically express the belief that the body and face hold signals to deception, more than speech content, a finding that has been labeled *the demeanor*

bias (Hartwig & Granhag, 2015). We can think of three reasons why this is the case: Nonverbal behaviour is supposed to be (1) important in the exchange of information, (2) difficult to control and (3) diagnostic in judging many social situations. First, there is a general belief that nonverbal behaviour is more informative in the exchange of information than speech content. A popular belief often mentioned in the media is that 93% of all communication occurs through nonverbal channels (Burgoon et al., 2016). This belief is derived from the work of Albert Mehrabian, carried out in the 1960s. In his paradigm, participants could only express one-word messages, such as ‘like’ or ‘dislike’ (Mehrabian, 1971; Mehrabian & Ferris, 1967; Mehrabian & Wiener, 1967). If someone hardly speaks, nonverbal behaviour naturally has to be the most important source of information. Obviously, this does not mean that this so-called ‘Mehrabian-rule’ can be applied to settings where someone speaks more. Mehrabian himself has spoken out about the incorrect interpretation of his research (<https://speakingaboutpresenting.com/presentation-myths/mehrabian-nonverbal-communication-research/>), as have others (Burgoon et al. 2016). In short, Mehrabian’s work has been widely misquoted, and has been used to prop up the widespread myth that nonverbal behaviour is informative about deception.

Yet, as Burgoon et al. (2016) argue, when observers perceive a mismatch between speech content and nonverbal behaviour, they typically rely more on the nonverbal message and conclude that the person was lying. They likely do so because they believe it is more difficult for the speaker to control nonverbal behaviour than speech (DePaulo & Kirkendol, 1989; Vrij, 2008). At least four reasons contribute to this belief (DePaulo & Kirkendol, 1989; Vrij, 2008). First, some behaviours may be beyond control of the lie teller, because they are supposedly linked to strongly felt emotions or high stress (Ekman, 1985/2009). Anger, for example, results in several

cues, including narrowing of the lips. Most people, however, cannot narrow their lips voluntarily (Ekman, 1985/2009). Second, people cannot be silent nonverbally. When a question throws a person off guard, s/he may need time to recompose him/herself and think of a good answer. However, there is no opportunity to pause nonverbally. Third, people are often not aware of their nonverbal behaviour because they do not see themselves. In fact, observers are typically more aware of someone's behaviour than the senders of these behaviours themselves (DePaulo, 1992). Lack of insight into own behaviour may make people unaware of subtle behaviours that they display. Fourth, when people actively address their nonverbal behaviour and try to appear credible, it is not guaranteed that they will manage to do so convincingly. It becomes acting, and there are individual differences in acting skills.

A third reason why people think that nonverbal behaviour is revealing about deception is that they may obtain high accuracy when observing behaviours in assessing many social situations (but see Epley, 2015 for a different view). A meta-analysis of accuracy in social perceptions revealed an average accuracy rate of 71% in judging numerous traits and states including intelligence, extraversion, conscientiousness, masculinity and dominance (Hall et al., 2008; see also Hall et al., 2019). As Hall et al. (2008) reported, this accuracy is substantially higher than the accuracy in determining veracity based on visual cues which is 50.35% (Bond & DePaulo, 2006). This 50.35% does not differ from chance level (50%). In other words, observers trust their nonverbal judgements in many social situations and mistakenly believe they can also trust their nonverbal judgements when assessing veracity. The reason for the exceptional low accuracy in judging veracity based on nonverbal behaviour is that lie tellers actively try to conceal their lies by using countermeasures: They attempt to suppress behaviours they believe look suspicious and replace this by behaviours they believe appear credible

(Hocking & Leathers, 1980). Since self-presentation and impression management is an integral part of ordinary life, people have ample practice and experience of regulating their demeanour (DePaulo, 1992; Goffman, 1959; Tedeschi, 2013).

The 50.35% accuracy rate derived from synthesizing the literature casts serious doubt on the belief that lie tellers have difficulty in controlling their demeanour. This is further demonstrated in a meta-analysis of differences in nonverbal behaviour between truth tellers and lie tellers that showed that nonverbal cues to deceit are typically faint and unreliable (DePaulo et al., 2003). In fact, in comparison to relying on nonverbal behaviours when attempting to detect deceit, relying on speech content appears to be more fruitful: Verbal cues to deceit are somewhat more revealing of deceit than nonverbal cues (DePaulo et al., 2003; see also Vrij et al., 2019); observers are worse in distinguishing between truths and lies when their judgements are based on visual cues ($d = .097$) than when they are based on audio cues ($d = .376$; Bond & DePaulo, 2006); and training in verbal cues to deceit results in a stronger positive effect than training in nonverbal cues to deceit (Hauch et al., 2016). In summary, although nonverbal lie detection is popular and sometimes recommended, the scientific literature rejects it as a reliable tool to detect deception.

Wearing a mask and actual indicators of deceit

When a defendant wears a mask in court, the only parts that are covered by the mask will be the nose and the lower part of the face. A mask may also affect the tone of voice. In other words, to establish whether a mask affects the actual cues that lie tellers display we should focus on the nose, lower face and voice. For actual cues to deceit we consulted the seminal meta-analysis by Bella DePaulo and colleagues (DePaulo et al., 2003). The findings are presented in Table 1, top part. It shows the cues (first column); the number of samples in which each cue was examined (second

column) and for each cue the Cohen d -effect size regarding discriminating between truth tellers and lie tellers (third column).

Insert Table 1 about here

Twenty-eight cues discussed in DePaulo et al. (2003) will be affected by mask wearing; many of them (21) were examined in fewer than five samples. Seven out of these 28 cues (25%) showed no relationship with deception at all ($d = .00$) and a further six (21%) showed a very small relationship with deception ($d < .10$). This reflects the conclusion that nonverbal cues to deceit are typically faint and unreliable. Seven cues (25%) showed a significant relationship with deception, six of them small (ranging from $d = .12$ to $d = .32$). Small effects are the equivalent of the difference in height between a 15- and 16-year old girl (about an inch) which is barely visible with the naked eye (Cohen, 1992; Rice & Harris, 2005). It is therefore unlikely that jurors would be able to notice such cues to deception in the courtroom. Only one cue (genuine smile) showed a substantial ($d = .70$) effect: Lie tellers display fewer genuine smiles than truth tellers. However, this result should be treated with caution because it was only examined in two samples. In addition, it is doubtful that lay people will be able to differentiate between genuine smiles and fake smiles as operationalised by Ekman and colleagues (Ekman & Friesen, 1982; Ekman et al., 1988). They are more likely to pay attention to smiles in general (the undifferentiated version), which has shown no relationship with deception ($d = .00$, Table 1, top part). We therefore conclude that there is unlikely to be a negative effect of mask wearing on the ability of jurors to detect deception.

Wearing a mask and perceived indicators of deceit

Observers (lay persons and professionals alike) overwhelmingly report to pay attention to gaze behaviour and movements when making judgments about deception

(Strömwall et al., 2004; Vrij, 2008). They strongly associate an increase in gaze aversion and an increase in movements with deception (Strömwall et al., 2004; Vrij, 2008). Since both cues are visible when defendants wear masks logic holds that mask wearing will not affect the cues observers overwhelmingly reporting paying attention to and, subsequently, will not affect their ability to detect deceit. As discussed before, lie detection accuracy is low if they focus on visual cues ($d = .097$).

The situation could be more complex because mask wearing may change the cues observers pay attention to. There are at least three options. First, observers could focus more on the part of the face that is still visible, which are the eyes. Second, observers could refrain from focusing on the face altogether and may focus on the body of the target person instead. Third, observers could refrain from observing visual cues and may focus on speech.

It is unknown how accurate observers are at distinguishing truth tellers from lie tellers when paying attention to eye movements. However, we can decipher this indirectly from DePaulo et al.'s (2003) meta-analysis. Six cues were included in that meta-analysis related to the eyes (Table 1, bottom part), three of them were examined fewer than five times. None of these six cues were related to deception and the d -scores ranged from $d = .01$ to $d = .11$. Based on these findings we can assume that observers will not be able to distinguish truth tellers from lie tellers by paying attention to eye movements.

Data are available on how accurate observers are at distinguishing truth tellers from lie tellers when they pay attention to (1) just the face, (2) just the body, (3) the face and body combined, or (4) listen to speech. A meta-analysis examining this (Bond & DePaulo, 2006) has shown that observers cannot discriminate between truth tellers and lie tellers if they focus on the target's face only (option 1, $d = .01$) or body only (option

2, $d = -.15$). Those two d -scores are similar to the earlier reported visual cues (face and body combined, option 3) d -score ($d = .097$), suggesting that the ability to discriminate between truth tellers and lie tellers will not change if observers focus only on the face, only on the body or on face and body combined. This is in contrast to when observers focus on speech (option 4), because that would improve their ability ($d = .376$).

To our knowledge, only one experiment related to mask wearing has been published. It examined the effect of wearing niqabs on truth and lie detection accuracy (Leach et al., 2016). It showed that if target persons wore niqabs, observers were more likely to base their decisions on verbal cues than when target persons wore no veil. Also, a significantly higher truth/lie detection accuracy was obtained in the niqab than the no veil condition (Leach et al., 2016). In other words, face covering made observers to switch their attention somewhat from visual cues to verbal cues (option 4) and improved their lie detection ability. This is in alignment with previously discussed findings that speech reveals more about deception than visual cues and that observers are inferior lie detectors when they focus on visual cues only. Taken together, there is no evidence that defendants' mask wearing would impair jurors' ability to distinguish between truth tellers and lie tellers – instead, there is some evidence that if anything, it may improve their ability by shifting their attention to more reliable signals.

In this section we assume that hearing (and understanding) the defendant is not impaired by mask wearing. This may be an incorrect assumption. Mask-wearing may muffle the defendant's speech, which may impair jurors' understanding of that speech or may impose greater cognitive load on jurors to process the speech. This scenario will make an improvement in lie detection when paying attention to speech content less likely.

A virtual courtroom

Rather than having defendants (and other court participants) wear masks in court and following social distancing rules, an alternative way to operate court proceedings during a pandemic is by holding legal proceedings in a virtual fashion. We expect many people to argue that virtual justice would hamper lie detection, similar to the view expressed by an attorney “I do not see how people can fully assess credibility if we are not all in the same room.” <https://www.theatlantic.com/magazine/archive/2021/05/can-justice-be-served-on-zoom/618392/>

The scientific literature discussed earlier shows that neither courtroom participants (nor society at large) need to be concerned. Virtual justice could mean that jury members have more or less access to some nonverbal channels. For example, when the camera zooms in on the defendant’s face, facial features would be more prominent for jurors than they would be in the courtroom, but body features would be less dominant or even absent. As we discussed above, the scientific literature shows that people are equally unsuccessful at discriminating between truths and lies when they pay attention to the face, the body or face and body combined.

There is a literature on modality effects in lie judgments which can inform the notion of virtual courtrooms, particularly literature comparing judgment accuracy and bias when the people whose veracity is to be assessed are presented either live/in person, or via video/CCTV (Buller et al., 1991; McCauliff & Kovera, 2002). Here, it is possible to predict different effects. For example, one could expect that a more immediate modality (i.e., live as opposed to video) may lead to closer and more granular scrutiny of the target, possibly leading to higher judgment accuracy. Alternatively, one could predict that a video presentation prompts a more objective evaluation than if the target appears in the same room, in turn leading to higher judgment accuracy.

In fact, the general pattern from the relevant literature on live vs. video presentation of targets of deception judgments shows null-effect on lie detection accuracy (Hartwig et al., 2004). That is, observers do neither worse nor better when they face a person live compared to when they view that person on video. However, the literature shows that lie judgments may be altered by modality – most prominently, it seems that video presentation makes observers more suspicious (e.g., Buller et al., 1991; Landström et al., 2005). That is, they make more lie judgments when they see the target on video compared to in person. To our knowledge, no compelling theoretical explanation for this finding has been offered – foreshadowing our discussion below, and using terminology from signal detection theory, it appears that seeing a person through the modality of video causes a criterion shift, whereby perceivers more readily judge a sender as being deceptive when they appear on a screen.

Making sense of the available data: A signal detection perspective

It is possible to view deception detection as a problem of signal detection (Meissner & Kassin, 2002). The signal detection literature originates in a view of decision problems which is also the foundation of Brunswikian psychology: The recognition that nearly all judgments and decision-making occur in an environment of uncertainty (Green & Swets, 1966; Tolman & Brunswik, 1935). That is, a decision-maker faces the problem of making judgments in an environment where signals may be marred by noise (for example, consider the behavioural noise a clinical diagnostician has to sift through in order to reach a conclusion regarding a patient). This view maps neatly onto the problem of determining whether a person is lying or telling the truth: Both demeanour and speech are unwieldy phenomena, and observers must cut through a tremendous amount of noise in order to detect a signal, if one exists at all. Before discussing the existence of a signal

to deception and its relation to face covering, we briefly explain some fundamental elements of signal detection theory.

Signal detection theory boils judgments down to whether the judge, or more generally, any system, alerts that a given signal has been detected or not. This state of affairs, wherein judgments and the actual state of affairs are both dichotomized, results in four possible outcomes. In the case of deception: 1) observers can correctly deem that deception is present when it actually is (a so-called hit, or true positive); 2) observers can incorrectly deem that deception is present when it actually is not (a false alarm/false positive); 3) they can deem that no deception is present when deception actually occurs (a miss/false negative); or 4) they can deem that no deception is present when there actually is none (a correct rejection/true negative).

People achieve poor accuracy rates when attempting to detect deception and make mistakes of all four types (Bond & DePaulo, 2006). In a Brunswikian meta-analysis of the deception literature, Hartwig and Bond (2011) found that the primary reason for failure in lie detection is *weakness in the signal* – that is, the now axiomatic finding that cues to deception are ‘faint, at best’ (DePaulo et al., 2003). The literature we have reviewed shows that signals of deception are virtually non-existent in the body – and of particular relevance for this paper, the face does not send signals of deception either. Viewed this way, the question of mask-wearing becomes moot: Since there are no reliable signals of deception in the face, it should not matter whether or not the sender is wearing a mask, because there is simply nothing there to detect.

Beyond lie detection accuracy, it is conceivable that mask-wearing causes a criterion shift – that is, that it leads observers to either become more suspicious or more credulous. At this point in time, there is no empirical answer to the question of whether this is the case.

Implications for jury instructions

Earlier, we described that to the extent that there is a signal to deception, it is most likely to be found in verbal cues, that is, speech. This finding raises the question about jury instructions. Since there is no empirical evidence support for demeanour-based cues, we strongly advocate against jury instruction including prompts to consider demeanour.

There are three reasons why we are not in favour of instructing jurors to pay attention to speech over demeanour either. First, if the instruction is too general it is unclear to which speech related cues observers will pay attention to – they may end up focusing on verbal cues that are not diagnostic of veracity. Second, DePaulo et al.'s (2003) meta-analysis showed that many verbal cues, albeit more diagnostic than nonverbal cues, are not particularly strong veracity indicators either – again, the problem is one of a weak signal.

Second, research has shown that verbal cues have potential to become strong indicators of deception but only when specific interview protocols are used that elicit or enhance such cues. Those interview protocols include Cognitive Credibility Assessment (CCA, Vrij et al., , 2015, 2017, 2021); Strategic Use of Evidence (SUE, Granhag & Hartwig, 2008; 2015; Hartwig et al., 2014); and the Verifiability Approach (VA, Nahari, 2018; Palena et al., 2020; Vrij & Nahari, 2019). For example, meta-analyses showed that the variable complications, part of CCA, resulted in $d = .62$ (Vrij et al., 2021); statement-evidence consistency, part of SUE, in $d = 1.89$ (Hartwig et al., 2014); and verifiable details, part of VA, in $g = .80$ (Palena et al., 2020).

However, these questioning protocols differ from the modes of questioning used in courtrooms (Denault & Jupe, 2018; Denault et al., 2017) and may not be

translatable to the courtroom question. The questioning protocols have in common that they often invite interviewees to report their version of events in as much detail as possible without any interruption. Courtroom questioning differs from many other interview settings in that mainly specific questions are asked (Denault & Jupe, 2018; Denault et al., 2017). In addition, to interpret the speech cues that are examined in the interviews protocols modelled after custodial interviews and interrogations, observers need to be trained what to pay attention to (Mac Giolla & Luke, 2021). Juror do not receive such training, which makes these interview protocols unsuitable -- at this time -- for use in the courtroom. We believe that testing and incorporating scientific principles into courtroom questioning is an important task for the future.

Third, it is unknown to what extent an instruction to jurors to pay attention to speech will impair their performance on other tasks. This includes crucial tasks such as assessing the strength of the evidence presented against the defendant, comparing the statements of different witnesses and following the rules of legal decision-making as provided by the judge.

We therefore prefer an instruction that does not refer to lie detection. In a Covid-specific context we propose the following instruction: ‘Although the defendant is wearing a mask, that should not affect your testimony. A mask may muffle someone’s speech. It is important that you can hear the defendant clearly, let the judge know if this is not the case.’

Concluding remarks

We have discussed the question of how wearing medical face masks affects lie detection, particularly in courtroom settings. The main conclusion emerging from our review of hundreds of studies on deception is that mask-wearing is largely a moot issue – the face is not a reliable source of information, therefore depriving observers

of parts of the face ought not to hamper them when detecting deceit. It may actually benefit them if it means that they will focus on speech content instead. We have also discussed the consequences of another measure to carry out justice proceedings during a pandemic, which is the use of a virtual modality. Based on our review of the literature, we believe the evidence suggests that mask-wearing should not impair jurors ability to detect deception.

In some ways, we deliver good news: It does not seem that measures to counter the spread of the COVID-19 virus (or any other virus that spreads in similar ways) will negatively impact observers. In other ways, we draw attention to fundamentally problematic aspects of lie detection, in particular, the fact that nonverbal behaviour is not helpful. It may be that the future lies in exploring the possibility of translating science-based interviewing and interrogation protocols to the courtroom setting to aid fact-finders in the pursuit of the truth.

Authors contributions

The first author wrote the first draft and second author amendment that draft and included additions.

References

- Blair, J. P., Levine, T., & Shaw, A. (2010). Content in context improves deception detection accuracy. *Human Communication Research, 36*, 423-442. Doi: 10.1111/j.1468-2958.2010.01382.x
- Bond, C. F., & DePaulo, B. M. (2006). Accuracy of deception judgments. *Personality and Social Psychology Review, 10*, 214-234. Doi: 10.1207/s15327957pspr1003_2
- Buller, D. B., Strzyzewski, K. D., & Hunsaker, F. G. (1991). Interpersonal deception: II. The inferiority of conversational participants as deception detectors. *Communication Monographs, 58*(1), 25-40. Doi: 10.1080/03637759109376212.
- Burgoon, J. K., Guerrero, L. K., & Floyd, K. (2016). *Nonverbal communication*. New York, NY: Routledge Taylor and Francis group.
- Cohen, P. (1992). A power primer. *Psychological Bulletin, 122*, 155-159. Doi: 10.1037//0033-2909.112.1.155.
- Denault, V., & Jupe, L. M. (2018). Justice at risk! An evaluation of a pseudoscientific analysis of a witness' nonverbal behavior in the courtroom. *The Journal of Forensic Psychiatry & Psychology, 29*(2), 221-242. Doi: 10.1080/14789949.2017.1358758
- Denault, V., Jupe, M. L., Dodier, O. & Rochat, N. (2017). To veil or not to veil, detecting lies in the courtroom: A comment on Leach et al. (2016). *Psychiatry, Psychology, & Law, 24*(1), 102-117. Doi: 10.1080/13218719.2017.1260619
- DePaulo, B. M. (1992). Nonverbal behavior and self-presentation. *Psychological Bulletin, 111*, 203-243. Doi:10.1037/0033-2909.111.2.203
- DePaulo, B. M., & Kirkendol, S. E. (1989). The motivational impairment effect in the communication of deception. In J. C. Yuille (Ed.), *Credibility assessment* (pp. 51-70). Dordrecht, the Netherlands: Kluwer.

- DePaulo, B. M., Lindsay, J. L., Malone, B. E., Muhlenbruck, L., Charlton, K., & Cooper, H. (2003). Cues to deception. *Psychological Bulletin*, *129*, 74-118. Doi: 10.1037/0033-2909.129.1.74
- Ekman, P. (1985). *Telling lies: Clues to deceit in the marketplace, politics and marriage*. New York: W. W. Norton. (Reprinted in 1992, 2001 and 2009).
- Ekman, P., & Friesen, W. V. (1982). Felt, false, and miserable smiles. *Journal of Nonverbal Behavior*, *6*, 238-252. Doi:10.1007/BF00987191
- Ekman, P., Friesen, W. V., & O'Sullivan, M. (1988). Smiles when lying. *Journal of Personality and Social Psychology*, *54*, 414-420. Doi: 10.1037/0022-3514.54.
- Epley, N. (2015). *Mindwise: Why We Misunderstand What Others Think, Believe, Feel, and Want*. Vintage Books.
- The Global Deception Research Team (2006). A world of lies. *Journal of Cross-Cultural Psychology*, *37*(1), 60–74. Doi: 10.1177/0022022105282295
- Goffman, Erving. 1959. *The Presentation of Self in Everyday Life*. New York: Anchor.
- Granhag, P. A. & Hartwig, M. (2008). A new theoretical perspective on deception detection: On the psychology of instrumental mind-reading. *Psychology, Crime & Law*, *14*, 189-200. Doi: 10.1080/10683160701645181
- Granhag, P. A., & Hartwig, M. (2015). The Strategic Use of Evidence (SUE) technique: A conceptual overview. In P. A. Granhag, A. Vrij, & B. Verschuere (Eds.), *Deception detection: Current challenges and new approaches* (pp. 231-251). Chichester, England: Wiley.
- Green, D. M., & Swets, J. A. (1966). *Signal detection theory and psychophysics* (Vol. 1). New York: Wiley.

- Hall, J. A., Andrzejewski, S. A., Murphy, N. A., Schmid Mast, & Feinstein, B. A. (2008). Accuracy of judging others' traits and states: Comparing mean levels across tests. *Journal of Research into Personality, 42*, 1476-1489. Doi: 10.1016/j.jrp.2008.06.013
- Hall, J. A., Horgan, T. G., & Murphy, N. A. (2019). Nonverbal communication. *Annual Review of Psychology, 70*, 271-294. Doi: 10.1146/annurev-psych-010418-103145
- Hartwig, M., & Bond, C. F. (2011). Why do lie-catchers fail? A lens model meta-analysis of human lie judgments. *Psychological Bulletin, 137*(4), 643–659. Doi: 10/1037/a0023589
- Hartwig, M., & Bond, C. F. (2014). Lie detection from multiple cues: A meta-analysis. *Applied Cognitive Psychology, 28*, 661-667. Doi: 10.1002/acp.3052.
- Hartwig, M., & Granhag, P. A. (2015). Exploring the nature and origin of beliefs about deception: Implicit and explicit knowledge among lay people and presumed experts. In *Detecting deception: Current challenges and cognitive approaches* (pp. 125–153). Wiley-Blackwell.
- Hartwig, M., Granhag, P. A., & Luke, T. (2014). Strategic use of evidence during investigative interviews: The state of the science. In: Raskin, D.C., Honts, C.R., Kircher, J.C. (Eds.), *Credibility Assessment: Scientific Research and Applications* (pp. 1-36). Oxford, UK: Academic Press.
- Hartwig, M., Granhag, P., Strömwall, L., & Vrij, A. (2004). Police officers' lie detection accuracy: Interrogating freely versus observing video. *Police Quarterly, 7*, 429–456. Doi: 10.1177/1098611104264748
- Hauch, V., Sporer, S. L., Michael, S. W., & Meissner, C. A. (2016). Does training improve the detection of deception? A meta-analysis. *Communication Research, 43*, 283–343. Doi: 10.1177/0093650214534974

- Hocking, J. E., & Leathers, D. G. (1980). Nonverbal indicators of deception: A new theoretical perspective. *Communication Monographs*, *47*, 119-131. Doi: /10.1080/03637758009376025.
- Landström, S., Granhag, P. A., & Hartwig, M. (2005). Witnesses appearing live versus on video: Effects on observers' perception, veracity assessments and memory. *Applied Cognitive Psychology*, *19*(7), 913–933. Doi: 10.1002/acp.1131
- Leach, A. M., Ammar, N., England, D. N., Remigio, L. M., Kleinberg, B. & Verschuere, B.J (2016). Less is more? Detecting lies in veiled witnesses. *Law and Human Behavior*, *40*(4), 401-410. Doi: 10.1037/lhb0000189
- Mac Giolla, E., & Luke, T. (2021). Does the cognitive approach to lie detection improve the accuracy of human observers? *Applied Cognitive Psychology*, *35*, 385-392. Doi: 10.1002/acp.3777.
- McAuliff, B. D., & Kovera, M. B. (2002). The status of evidentiary and procedural innovations in child abuse proceedings. In B. L. Bottoms, M. B. Kovera, & B. D. McAuliff (Eds.), *Children, social science and the law* (pp. 412–445). New York: Cambridge University Press.
- Mehrabian, A. (1971). *Silent messages, 1st edition*. Belmont, CA: Wadsworth.
- Mehrabian, A., & Ferris, S. R. (1967). Inference of attitudes from nonverbal communication in two channels. *Journal of Consulting Psychology*, *31*, 248–252. Doi: 10.1037/h0024648
- Mehrabian, A., & Wiener, M. (1967). Decoding of inconsistent communications. *Journal of Personality and Social Psychology*, *6*, 109–114. Doi: 10.1037/h0024532
- Meissner, C. A., & Kassin, S. M. (2002). “He’s guilty!”: Investigator bias in judgments of truth and deception. *Law and Human Behavior*, *26*(5), 469–480. Doi: 10.1023/A:1020278620751

- Nahari, G. (2018). The applicability of the Verifiability Approach to the real world. In P. Rosenfeld (Ed.). *Detecting concealed information and deception: Verbal, behavioral, and biological methods* (pp. 329-350). San Diego, CA: Academic Press. Doi: 10.1016/B978-0-12-812729-2.00014-8.
- Palena, N., Caso, L., Vrij, A., & Nahari, G. (2020). The Verifiability Approach: A meta-analysis. *Journal of Applied Research in Memory and Cognition*. Doi: 10.1016/j.jarmac.2020.09.001
- Park, H. S., Levine, T. R., McCornack, S. A., Morrisson, K., & Ferrara, M. (2002). How people really detect lies. *Communication Monographs*, 69, 144-157. Doi:10.1080/714041710
- Rice, M., & Harris, G. T. (2005). Comparing effect sizes in follow-up Studies: ROC Area, Cohen's *d*, and *r*. *Law & Human Behavior*, 29, 5, 615 – 620. Doi:10.1007/s10979-005-6832-7
- Strömwall, L. A., Granhag, P. A., & Hartwig, M. (2004). Practitioners' beliefs about deception. In P. A. Granhag & L. A. Strömwall (Eds.), *Deception detection in forensic contexts* (pp. 229-250). Cambridge, England: Cambridge University Press.
- Tedeschi, J. T. (Ed.). (2013). *Impression management theory and social psychological research*. Academic Press.
- Tolman, E. C., & Brunswik, E. (1935). The organism and the causal texture of the environment. *Psychological Review*, 42(1), 43–77. Doi: 10.1037/h0062156
- Vrij, A. (2008). *Detecting lies and deceit: Pitfalls and opportunities, second edition*. Chichester: John Wiley and Sons.
- Vrij, A., Fisher, R., Blank, H. (2017a). A cognitive approach to lie detection: A meta-analysis. *Legal and Criminological Psychology*, 22, 1-21. Doi:10.1111/lcrp.12088

- Vrij, A., Hartwig, M., & Granhag, P. A. (2019). Reading lies: Nonverbal communication and deception. *Annual Review of Psychology, 70*, 295-317. Doi: 10.1146/annurev-psych-010418-103135
- Vrij, A., Leal, S., Mann, S., Vernham, Z., & Brankaert, F. (2015). Translating theory into practice: Evaluating a cognitive lie detection training workshop. *Journal of Applied Research in Memory and Cognition, 4*, 110-120. Doi:10.1016/j.jarmac.2015.02.002
- Vrij, A., Mann, S., Kristen, S., & Fisher, R. (2007). Cues to deception and ability to detect lies as a function of police interview styles. *Law and Human Behavior, 31*, 499-518. Doi: 10.1007/s10979-006-9066-4
- Vrij, A. & Nahari, G. (2019). The Verifiability Approach In J. J. Dickinson, N. Schreiber Compo, R. N. Carol, B. L. Schwartz, & M. R. McCauley (eds.) *Evidence-Based Investigative Interviewing* (pp. 116-133). New York, U.S.A.: Routledge Press.
- Vrij, A., Palena, N., Leal, S., & Caso, L. (2021). The relationship between complications, common knowledge details and self-handicapping strategies and veracity: A meta-analysis. *European Journal of Psychology Applied to Legal Context.*
- Vrij, A., & Turgeon, J. (2018). Evaluating credibility of witnesses: Are we instructing jurors on invalid factors? *Journal of Tort Law, 11*, 231-244. Doi: 10.15/jtl-2018-0013

Table 1. Diagnostic (non)verbal cues to deceit based on at least six measurements

Cues related to the lower face	k (number of samples)	d-score
11 pressed lips	4	.16*
17 facial expressiveness	3	.12
32 loudness	5	-.05
33 chin raise	4	.25*
54 facial pleasantness	13	-.12*
57 sneers	4	.02
58 smiles (undifferentiated)	27	.00
59 lip corner pull	4	.00
62 vocal tension	10	.26*
63 pitch frequency	12	.21*
86 facial shielding	4	.00
88 intensity of facial expression	2	-.32*
89 face changes	7	-.06
94 pitch variety	2	.12
95 pitch changes	1	.42
97 loudness variety	1	.00
104 facial immediacy	2	.13
117 genuine smile	2	-.70*
118 feigned smile	2	.31
120 mouth asymmetry	1	.14
121 relaxed face	1	-.29
130 lip stretch	4	-.04
132 lips apart	5	-.08

133 jaw drop	3	.00
148 lip pucker	2	-.08
149 tongue out	2	-.16
150 duration of facial expression	2	.00
156 biting lips	1	.00
Cues related to the eyes		
27 eye contact	17	.01
28 gaze aversion	6	.03
29 eye shifts	7	.11
60 eye muscles not during positive emotion	4	-.01
104 facial immediacy (eye contact and head orientation)	2	.13
131 eyes closed	3	-.06

Note: Taken from DePaulo et al. (2003), cue number refer to cue numbering in DePaulo et al. (2003)

Note: Negative *d*-scores indicate truth telling and positive *d*-scores indicate lying.