Secrets of the Human Face:

New Insights Into the Face and Covert Emotions

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Abstract

Deception is a fundamental aspect of human communication and often is accompanied by facial expressions simulated or concealed to be consistent with the false message. Darwin hypothesized that some facial muscle actions are beyond voluntary control and may “leak” genuine emotion or reveal falsified expressions. Despite uncritical acceptance of this notion in scientific and popular media arenas, little empirical work existed to substantiate these claims prior to our recent studies. Laboratory-based experiments substantiate Darwin’s claims; emotional leakage is most likely to occur during masking (attempting to conceal one’s felt emotion with a simulated expression), particularly when the to-be-concealed emotion is strongly felt. Although individual differences related to emotional intelligence and psychopathic traits - in emotional fabrication ability exist, careful attention to the face can also reveal deceit in high-stakes, emotional, real-world situations. Televised footage of a large international sample of individuals emotionally pleading to the public for the return of a missing relative was meticulously coded for emotional presentation. About half of the pleaders eventually were convicted of killing the missing person based on overwhelming evidence. Failed attempts to simulate sadness and leakage of genuine happiness revealed deceptive pleaders’ covert emotions and, in combination with verbal cues, differentiated honest and dishonest pleaders with unprecedented accuracy in the study of deception detection. These findings offer an important and novel advancement in our understanding of involuntary aspects of human communication.
Secrets of the Human Face: New Insights Into the Face and Covert Emotions

My (first author) research team has spent the past decade conducting a comprehensive investigation of how covert emotional information is communicated in the human face. We have coded millions of frames of videotaped facial expressions - in both highly-controlled lab experiments and “real-life” emotional scenarios - with the goal of solving some of the mysteries and resolving some of the controversies around emotional deception. In this paper, we summarize the key observations to come out of this body of work.

In addition to a basic interest in emotional communication, I had practical motivation to pursue this line of research. While interning in a prison during my training as a forensic psychologist, I provided individualized treatment to a psychopathic sexual offender who - after eleven months of sessions - appeared to me to be making tremendous progress in therapy, assuming responsibility, expressing remorse, and exhibiting empathy for his victims. As I was preparing a positive evaluation of his therapeutic progress, his journal was confiscated during a cell-search. In the journal, he detailed his progressively more violent and sadistic sexual fantasies, suggesting that his criminal tendencies had been exacerbated during the course of treatment, and revealed the fact that he was “fooling his stupid shrink”. This incident sparked my interest in the deceptive behaviour and our natural (in)ability to detect deception. What made me believe this seemingly sincere offender? And how can I (and other professionals) accurately detect such deceit in the future?

The Face as a Window to the Soul

The complex musculature of the human face and its direct relation with affective processes of the brain makes it a rich canvas upon which humans communicate their emotional
states and from which we infer those of others. In daily life, we “read” the faces of intimates and strangers to make inferences about their emotions and intentions, and adopt expressions ourselves to communicate genuinely or falsely how we are feeling. Indeed, the face is a primary focus of attention upon meeting a stranger. Valenza, Simion, Cassia, and Ultimà (1996) found that infants showed a visual preference for face-like patterns. Throughout life, it continues to be the focal point in social situations, directing both conversation and decisions about further interaction. Based on a glimpse of a stranger’s face, observers form instantaneous (less than $1/10^{th}$ of a second) and enduring impressions about that individual’s trustworthiness (Porter & ten Brinke, 2009; Willis & Todorov, 2006). The foundation of this process originates in our evolutionary past; the discrimination of friend versus foe likely involved an assessment of the stranger’s emotional state and physical strength and was one of the earliest interpersonal judgments to evolve (e.g., Todorov, 2008; Williams & Mattingley, 2006).

Indeed, some traits and intentions can be accurately inferred from a glimpse of a stranger’s face. For example, personality traits such as extraversion and conscientiousness can be judged at an accuracy level greater than chance just by viewing a face (Little & Perrett, 2007). Further, observers can distinguish males seeking relationships versus those who are interested in casual sex, just by looking at their faces (Boothroyd et al., 2008). In an investigation of the undefined concept of “creepiness”, we found that pictures of men were creepier than women and sexual offenders were perceived as creepier than those of other violent offenders (Porter, ten Brinke, Shaw, & Strugnell, 2011). However, no available evidence suggests that first impressions of trustworthiness, specifically, are accurate. In a recent study, participants provided trustworthiness ratings of violent America’s Most Wanted criminals and philanthropists (Porter, England, Juodis, ten Brinke, & Wilson, 2008). Participants were able to distinguish between the
two groups only slightly above the level of chance. Despite the inaccuracy of these assessments, they can have a strong biasing effect on subsequent decisions about the individual concerned. In a mock juror paradigm, participants more often rendered a guilty verdict for untrustworthy-versus trustworthy-looking defendants accused of (the same) homicide (Porter, Gustaw, & ten Brinke, 2010). Thus, although we ‘read’ faces on a daily basis, findings suggest we are subject to error, sometimes resulting in ‘misreading’ a face and the construction of an inaccurate impression/representation of a person’s actual intentions, emotional state, or character more generally.

The inaccuracy of trustworthiness assessments may be due, in part, to the evolved ability to alter facial expression in order to conceal or fabricate emotional information. In the modern context, the identification of falsified emotions is important in everyday life, the courts, parole hearings, politics, and corporations. Jung (1959) proposed that individuals have a preferred persona (or mask-like) archetype or image that we choose to project to the world in order to protect ourselves from negative evaluations. Most people want to display themselves in a way that will benefit them in all areas of their life (e.g., work, relationships, etc.), even if that means presenting a false persona. So how do we know when people are being honest? Deception is a fundamental aspect of human interaction that often acts to promote social cohesion. Research finds that people lie, on average, two times per day (DePaulo, Kashy, Kirkerdol, Wyer, & Epstein, 1996). For example, the wise husband responds with a nod and a loving smile when his wife asks his opinion of her new dress, regardless of his genuine evaluation.

Despite the ubiquity of deception in our daily lives, we are naturally poor lie detectors (Bond & DePaulo, 2006). Is a passenger a potential threat? Is an offender’s emotional display/remorse in a parole or sentencing hearing genuine? Much research demonstrates that
observers generally are unable to discriminate genuine vs. faked expressions (Porter & ten Brinke, 2008; Porter et al., 2010), despite high confidence in such evaluations (Vrij & Mann, 2001). Porter, ten Brinke, and Wilson (2009) found that psychopaths were 2.5 times as likely as their counterparts to be successful in parole applications, which we hypothesized related to Academy Award-winning acting jobs. Clearly, credibility assessment is not a common sense task, contrary to the views of the Supreme Court of Canada (R. v. B. (K. G.), 1993).

Alluding to my personal incident I discussed earlier, it is of particular interest to me how people can deceive others so easily while speaking face-to-face. Previous research has suggested that individuals generally associate face-to-face lying with various nervous behaviours such as speech disturbances, gaze aversion, body movement, and fidgeting (e.g., Vrij, 2008). These stereotypes are also shared by the judiciary; in Morales v. Artuz, the judge noted that ‘seeing a witness’s eyes has sometimes been explicitly mentioned as of value in assessing credibility’. However, assessments of credibility based on nervous behaviour are likely to be inaccurate because these indicators are not substantiated by empirical research (Vrij, 2000) and can also be confounded by other factors, such as culture. For example, many aboriginals avert their gaze as a sign of respect when interacting with other individuals (see Porter & ten Brinke, 2009). Given the apparent complexities of using voluntary body language behaviours as a cue to deception, recent research in my lab has focused on emotional deception via the alteration of universal facial expressions (happiness, sadness, fear, contempt, disgust, surprise, anger; Ekman, Sorenson, & Friesen, 1969; Matsumoto & Willingham, 2006) – a concept dating to the 19th century.

**Emotional Expression as a Cue to Deception**
In 1862, Duchenne, a French neurologist, conducted the first experimental study that examined prototypical expressions of emotion, using electrical stimulation of facial muscles. He noted that the common notion of the happiness facial expression is the contraction of the zygomatic major muscle, which pulls the mouth corners upwards into a smile. When this muscle was electrically stimulated, he found that the resulting smile (in the absence of felt happiness) did not appear complete. Indeed, this was an inadequate expression of happiness because it did not involve the contraction of the orbicularis oculi surrounding the eye (pulling the cheek up and causing wrinkles, or “crow’s feet”, to form around the eye). Duchenne concluded that simultaneous contractions of these two muscles are necessary to produce a genuine expression of happiness (later established by Ekman, Davidson, & Friesen, 1990).

Following Duchenne’s ground-breaking work, Darwin (1872) later proposed the inhibition hypothesis, which suggests that facial actions associated with strong emotion cannot be inhibited voluntarily, and that the same muscle actions cannot be engaged voluntarily during emotional stimulation (Ekman, 2003). He further postulated that more powerful emotions would be associated with more “leakage” than less potent emotions. A related proposal by Ekman (1992) is that when an emotion is concealed, a manifestation of the true emotion is revealed in the form of a micro-expression, a full-face expression lasting $1/25^{th} - 1/5^{th}$ of a second (Ekman, 1992; Ekman & O’Sullivan, 2006).

Although the inhibition hypothesis, in general, and Ekman’s micro-expression specifically, were widely assumed to be valid, they received little empirical scrutiny until recently. From 2005 to present, we have conducted five studies that exhaustively analyzed thousands of genuine and falsified emotional facial expressions to meticulously examine these related proposals.
Testing the Inhibition Hypothesis and Searching for Micro-expressions

We conducted the first empirical study to directly examine the assumption that facial expressions are involuntary, uncontrollable, and can “leak” one’s true feelings (Porter & ten Brinke, 2008). To examine the presence of emotional leakage, expressions inconsistent with the intended emotional portrayal, and search for the presence of micro-expressions, participants viewed happy, sad, disgusting, frightening, and neutral images, and were asked to respond to each image with either a genuine or deceptive facial expression. We analyzed each 1/30th-second frame to determine the presence and duration of universal facial expressions, the frequency of micro-expressions, and blink rate; a total of 104,440 frames in 697 expressions were analyzed. We found that relative to genuine emotions, masked – or deceptive – expressions were associated with more inconsistent expressions. In other words, masking one’s true emotions does indeed result in more emotional leakage than is present during genuine expressions. Further, findings suggest that negative emotions (i.e., sadness, fear, disgust) were more difficult to falsify compared to positive emotions (i.e., happiness). Finally, inconsistent emotional leakage occurred in 100% of participants at least once, and most often lasted longer than the micro-expression defined by Ekman (1992). Micro-expressions only occurred in 21.95% of participants, in 2% of all facial expressions exhibited, and were not full-face expressions. Despite the presence of lengthy emotional leakage, naïve observers performed at the level of chance when detecting deceit.

In a recent follow-up study, we examined the influence of emotional intensity on people’s ability to conceal and falsify emotional expressions (Porter, ten Brinke, & Wallace, 2011). Participants viewed happy, sad, frightening, disgusting, and neutral images that were previously rated in emotional intensity. Again, each 1/30th-second frame of 1711 expressions was analyzed
for the duration and intensity of universal expressions, totaling 256,650 frames. Our findings lent further support to Darwin’s (1872) hypotheses. High intensity emotion was more difficult to conceal than low intensity emotion, and occurred in 98.3% of participants during false emotional masking. Specifically, emotional leakage was displayed for a longer time in the upper versus lower face. Further, and replicating findings of Porter and ten Brinke (2008), leakage occurred more often during negative expressions (sadness, fear, disgust), and particularly during fear. And again, we found that observers were unable to differentiate between genuine and false emotions above the level of chance.

**Individual Differences in Emotional Leakage**

Although our previous research had established that emotional leakage often occurs, in our third study we hypothesized that individual differences in psychopathic traits and emotional intelligence would relate to the likelihood and duration of emotional leakage during deceptive facial expressions (Porter, ten Brinke, Baker, & Wallace, 2011). As with the above lab-based studies, participants were asked to simulate insincere expressions in relation to a neutral or powerful emotional image (e.g., respond to a sad image with an expression of happiness). As predicted, our findings suggested that those high in psychopathy and emotional intelligence each had enhanced, but different, abilities at adopting deceptive facial expressions. Psychopathy - particularly interpersonal manipulation - was related to less emotional leakage during deceptive displays, whereas emotional intelligence was related to more convincing displays during emotional simulation. However, in accordance with Darwin’s (1872) *inhibition hypothesis*, no participants (regardless of emotional intelligence and psychopathy) were immune to emotional leakage.

**Emotional Leakage During Displays of Fabricated Remorse**
Research suggests that psychopathic individuals are proficient emotional deceivers and are able to manipulate their way to reduced sentences and early releases in parole and sentencing hearings (e.g., Hakkanen-Nyholm & Hare, 2009; Porter, ten Brinke, & Wilson, 2008). While we postulated that psychopaths feign remorse to achieve leniency in these settings, no research had yet examined the behavioural differences between genuine and deceptive remorse. We examined, for the first time, the possible presence of leakage in the facial expressions of individuals pretending to be remorseful (ten Brinke, MacDonald, Porter, & O’Connor, 2011). Participants were videotaped while relating two true autobiographical transgressions, accompanied by either genuine or false remorse (i.e., the participant describing a serious transgression for which he/she felt powerful remorse, or felt no remorse but feigned remorse). After analyzing nearly 300,000 frames, we found that descriptions of falsified remorse were associated with a greater range of emotional expressions. Whereas real remorse was associated with sincere expressions of sadness, false remorse contained leakages of anger and happiness. In addition, falsified remorse was emotionally turbulent, with negative and positive expressions often following each other directly. In contrast, emotional expressions in genuine remorse progressed through neutral expressions.

Emotional Facial Leakage Reveals High-Stakes Interpersonal Deception

In our most recent research, we left the laboratory context and conducted the most comprehensive study to date of extremely high-stakes, real-life deception with a novel paradigm (ten Brinke & Porter, 2011). Televised footage of a large international sample of individuals emotionally pleading to the public for the return of a missing relative was meticulously coded frame-by-frame (74,731 frames). About half of the pleaders eventually were convicted of killing the missing person based on overwhelming evidence. Failed attempts to simulate sadness and
leakage of smiles revealed deceptive pleaders’ covert emotions. Falsified and incomplete expressions of sadness were prominent during deceptive portrayals; typically deceivers failed in contracting the muscles associated with true distress in the forehead region and instead exhibited facial expressions that more closely resemble surprise. In addition, we found leakage of happiness (i.e., smirks) in the lower face of the deceptive pleaders. Deceptive pleaders also provided shorter pleas and used more tentative language in their messages. The combination of these four cues could discriminate deceptive murderers from genuinely distressed relatives at 90% accuracy.

In a follow-up study (ten Brinke, Porter, & Baker, 2011), we investigated the specific facial muscle action units (AUs; Ekman, Friesen, & Hagar, 2002) associated with these deceptive and genuine pleas by focusing on five crucial muscles: *frontalis* (AU1+2), *corrugator supercilli* (AU4), *zygomatic major* (AU12), and *depressors* (AU15). The prototypical expression of sadness in the upper face is characterized by activation of the *frontalis* (raising the eyebrows upward) and activation of the *corrugator supercilli* (lowering and pulling together of the eyebrows, creating a furrow). While most people can voluntarily activate the *frontalis* fairly easily, contraction of the *corrugator supercilli* is a more difficult task, particularly when cognitive load is heavy during high-stakes deception. Activation of the *depressors*, pulling the lip corners downward into a frown, completes the expression of sadness. Our results indicated that genuine pleaders were more likely to activate grief muscles (*corrugator supercilli* and *depressors muscles*), whereas deceptive pleaders were more likely to activate the *frontalis* and *zygomatic major* (turning the mouth upward into a smile) muscles. The muscle activation pattern of deceptive pleaders likely reflected failed attempts at sadness in the upper face and leakage of
masking smiles in the lower face. This important extension reveals that particular muscles
deserve attention when attempting to reveal the false face.

Conclusion

In summary, our research studies collectively emphasize the importance of the human
face in revealing covert emotional information. In accordance with the inhibition hypothesis
(Darwin, 1982; Ekman, 2003), our research supports the contention that people cannot
completely inhibit powerfully felt emotions and are likely to fail when attempting to falsify these
expressions in the absence of emotion. In both highly-controlled and real-life contexts, emotional
leakage occurs that can be identified by the informed observer. Indeed, the secrets of the human
face finally are being revealed empirically.
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