Darwin, Deception, and Facial Expression

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ABSTRACT: Darwin did not focus on deception. Only a few sentences in his book mentioned the issue. One of them raised the very interesting question of whether it is difficult to voluntarily inhibit the emotional expressions that are most difficult to voluntarily fabricate. Another suggestion was that it would be possible to unmask a fabricated expression by the absence of the difficult-to-voluntarily-generate facial actions. Still another was that during emotion body movements could be more easily suppressed than facial expression. Research relevant to each of Darwin's suggestions is reviewed, as is other research on deception that Darwin did not foresee.

KEYWORDS: Darwin; deception; facial expression; lies; lying; emotion; inhibition; smile; leakage; micro-facial-expressions; Facial Action Coding System; illustrators; pitch; Duchenne; asymmetry

The scientific study of the facial expression of emotion began with Charles Darwin's *The Expression of Emotions in Man and Animals*, first published in 1872.[1] Among his many extraordinary contributions Darwin gathered evidence that some emotions have a universal facial expression, cited examples and published pictures suggesting that emotions are evident in other animals, and proposed principles explaining why particular expressions occur for particular emotions—principles that, he maintained, applied to the expressions of all animals. But Darwin did not consider at any length when, how, and why emotional expressions are reliable or misleading.

Neither *deception* nor *lies* (or *lying*) appears in the index to his book. In the 19-page conclusion there is only one sentence that refers to this: "They [the movements of expression] reveal the thoughts and intentions of others more truly than do words, which may be falsified" (p 359). A bit too simple; for surely we know—and research has documented[2,3]—that some facial expressions can be very misleading. In brief comments elsewhere Darwin provides a more complex view, suggesting how true feelings may be shown despite efforts to conceal emotions and also how false expressions, which display emo-

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tions not felt, may be betrayed. Much research has supported and sometimes qualified his comments.[a]

Darwin suggested that muscles that are difficult to voluntarily activate might escape efforts to inhibit or mask expression, revealing true feelings. "[W]hen movements, associated through habit with certain states of the mind, are partially repressed by the will, the strictly involuntary muscles, as well as those which are least under the separate control of the will, are liable still to act; and their action is often highly expressive (p. 54)." The same idea in somewhat different words: "A man when moderately angry, or even when enraged, may command the movements of his body, but . . . those muscles of the face which are least obedient to the will, will sometimes alone betray a slight and passing emotion" (p. 79).

INHIBITING EXPRESSION

Two very interesting ideas are contained in these brief quotations. The first is Darwin's suggestion that if you cannot make an action voluntarily, then you will not be able to prevent it when involuntary processes such as emotion instigate it. I am going to refer to this as the *inhibition hypothesis* to distinguish it from another idea contained in this quotation that I will get to later. Darwin does not explain why this might be so, but it is well known that the facial nucleus, which transmits impulses to the specific muscles to contract or relax, receives impulses from many different parts of the brain. The motor cortex is the source of the impulses resulting from voluntary efforts to make a facial expression. Other lower areas of the brain send impulses to the facial nucleus when emotions are aroused involuntarily. Clinical reports about certain neurological disorders[4–7] support the distinction between voluntary and involuntary facial actions, between facial movements that are easy and hard to make deliberately.

Each type of expression may depend upon different potentially independent neural pathways. Lesions in the pyramidal systems impair the ability to perform a facial movement on request, such as the ability to smile when asked to do so; yet they may leave emotional expressions intact, so that the patient might smile if amused by a joke. Lesions in the nonpyramidal systems may

[a]I considered in this chapter all the research I have found comparing voluntary and involuntary facial expressions, but I have excluded most of the research on deception and demeanor for the following reasons: most of it did not actually meaasure facial expression—or, if it did, the measurement was very crude; most dealt with trivial lies, where the rewards were of little consequence, and if there was any punishment, it was slight; most did not threaten punishment to anyone considered to be lying, regardless of whether the person actually was being truthful; most did not allow their subjects to choose whether to lie or tell the truth. In short, with few exceptions, the research on interpersonal deception carried out by other than our own group has had no ethological validity.

produce the reverse pattern; so, for example, a patient could smile on request but might not do so spontaneously.

But Darwin's inhibition hypothesis goes beyond simply distinguishing between voluntary and involuntary facial muscular actions. He said that if you cannot voluntarily activate a muscle, then you will not be able to voluntarily inhibit its involuntary activation in a spontaneous emotional expression. This sounds reasonable, but what would be the neural mechanism responsible for such a defect in inhibition? I asked a research neurologist, Bruce Miller, who studies emotion in various neurological disorders, if we could assume that those actions that are difficult to perform voluntarily must have poor representation in the motor cortex; and if that is so, would such poor representation in the motor cortex be responsible for the failure of voluntary efforts to inhibit those actions when they are directed by nonpyramidal systems. He said: "I don't know if there is any data on what part of the brain is involved in the voluntary inhibition of a smile, but I don't think that it necessarily involves the motor cortex. It is possible that there is a system involved with the inhibition of the smile that is still intact in a patient who cannot voluntarily smile. In fact, that is my guess" (personal communication October 2002).

It is remarkable that we do not know the answer; but now that we have focused on the question, I hope others will pursue it in studies of neurological patients. However, it is not necessary to know the neural substrates involved in order to check through behavioral observation Darwin's inhibition hypothesis. To determine whether Darwin was correct in proposing that if you cannot deliberately contract a muscle, you will not be able to deliberately prevent that muscle from contracting when it is activated involuntarily we must first identify which facial actions are difficult to make deliberately. We did that more than 20 years ago.[8] TABLE 1 shows the actions that fewer than 25% of our subjects could deliberately produce. If Darwin is correct, then these movements should provide what we have called *leakage* of felt emotions,[9] betraying how a person feels even when the person attempts to conceal that

TABLE 1. Action units

Latin Name	Name in FACS	Associated Emotion
Orbicularis oris	24: lip pressor	anger
Triangularis	15: lip corner depressor	sadness
Depressor labii inferioris	16: lower lip depressor	disgust, sadness
Frontalis, pars medialis	1: inner brow raiser	sadness
Frontalis, pars lateralis	2: outer brow	—
(Corrugator = AU 4)	1+4	sadness
	1+2+4	fear
Risorius	20: lip stretcher	fear
Orbicularis oculi, pars lateralis	6: raises cheeks, narrows eyes	enjoyment, sadness

information. Examining videotapes of people lying and telling the truth, we have seen, again and again, instances in which the activity of these muscles are not inhibited—not in all people, but in many. I have called the actions listed in TABLE 1 the *reliable* facial muscles.[10] I am embarrassed to confess that because it seemed so obvious, we never quantitatively tested Darwin's inhibition hypothesis.

WHICH IS MORE RELIABLE, THE FACE OR THE BODY?

The second idea contained in those brief quotations from Darwin is that people can "command" the movements of the body when angry (and presumably in any other emotion), and therefore bodily movement, unlike the reliable facial muscles, should be easy to conceal. This I have called the *face>body leakage hypothesis*. The evidence does not support Darwin's hypothesis. It is a more complex matter than one source, the face or the body, being a better source of leakage than the other.

We have proposed that, although bodily movements of the hands and feet would be easy to inhibit, consistent with Darwin's reasoning in the face>body leakage hypothesis, most people do not bother to censor their body movements.[9] Because most of us do not get much feedback from others about what our body movements are revealing, we do not learn the need to monitor these actions; and so, we hypothesized, when people lie, they usually do not fine-tune their body actions. If we are right, the body will be a good source of deception clues—exactly the opposite of what Darwin predicted.

Since people generally receive more comments on their facial expression, we predicted that people would focus their deceptive efforts on managing this, and thus the face would be a less useful source than the body of information about lying versus truthfulness. Our theorizing was only partly supported by the experiments we then conducted; it was a more complex matter than we anticipated.

In our first study we showed groups of observers videotapes of women who had either lied or told the truth about whether they were experiencing enjoyment induced from watching nature films.[2] Half of them were actually watching gory films, claiming falsely that they were feeling positively about watching nature films. The observers saw either the face or the body of the subjects when they were being interviewed about how they felt. The words spoken were not provided. The judgments made by the observers were more accurate when made from the body than from the face. This was so only in judging the deceptive videos, and only when the observers were also shown a sample of the subjects' behavior in a baseline, nonstressful condition.

Another finding was consistent with the reasoning underlying our proposal that the body provides more leakage than the face. The women who had been videotaped lying and telling the truth about what film they were seeing and

how they felt were asked after the experiment what aspects of their behavior they had focused on controlling when they lied. Nearly all mentioned the need to manage their facial expressions; only a few referred to the need to manage their body movements.

Now let us consider another finding, which partially contradicted our proposal that the body is a better source of information than the face and is consistent instead with Darwin's face>body leakage hypothesis. Darwin is only partially supported by the finding I next describe because the face, it turned out, was an accurate source of information, but for only a limited number of special people. Before describing this and subsequent findings, I must first explain a subtlety in facial expression that we uncovered.

In the late 1960s before we did this experiment we discovered *micro facial expressions* when examining our films of psychiatric patients who had lied during a clinical interview, concealing either plans to commit suicide or hallucinations. We defined *micro expressions* as being

> … so brief that they are barely perceptible to the untrained observer. Micro displays may be fragments of a squelched, neutralized or masked display. Micro displays may also show the full muscular movements associated with macro affect display, but may be greatly reduced in time. We have found that such micro displays when shown in slow motion do convey emotional information to observers, and that expert clinical observers can see micro displays and read the emotional information without the benefit of slow motion projection [p. 27].[9,b]

In our first paper on deception we proposed that

> … the face is equipped to lie the most and leak the most, and thus can be a very confusing source of information during deception. … [A person] can get away with and best perpetrate deception through his face. Although he must monitor quickly and work continually to inhibit this fast responsive system, he has most awareness of his facial display and is usually well practiced in the display rules for modulating facial affects. … [T]he face is the major site for lies of commission [through macro expressions, which are large in scope and of sufficient duration to be readily seen]. … [Most people will ignore or disregard such] important sources of information as micro displays and the rough edges on the simulated display. … [O]ne would expect the usual observer of the face typically to be misled. One would expect the keen observer, on the other hand, to receive contradictory information from facial cues: simulated messages, micro leakage of information which contradicts the simulations, and deception clues of squelched displays and improperly performed simulations [pp. 98–99].[9]

[b]A few years earlier Haggard and Isaacs described having seen what they called "micro-momentary expressions."[50] They thought these expressions are not detectable without slow-motion viewing. We know that is not so, that some people can detect them at real time. They also said micro expressions are the result of repression, revealing information about which the person is unaware. We have no reason to doubt that does occur, and in a few clinical case studies we found support for their contention; but micro expressions also occur with deliberate concealment.

By this reasoning people who are highly trained in observing facial movement might have made accurate judgments when they saw the videotapes of the subjects who had lied or told the truth about the emotions they felt. We showed the face-only videotapes to four associates who had been using our first technique for measuring the face[11] for more than a year. Each of these four people achieved an accuracy score of 80% or higher. So the face does contain accurate information, as well as misinformation, when people lie. Most people respond to the macro expressions and are misled, while a few keen observers detect the micro expressions and other imperfections in the macro displays and are correctly informed.

Let me summarize where we are in the argument and the evidence before proceeding. Although Darwin was correct—the skeletal muscles that generate body movements are easy to "command" and on that basis should not leak—we were correct in noticing that most people do not censor their body movements when they lie because they have not found that the targets seem to notice what they do with their body. This reasoning was supported by the finding in the experiment in which observers who saw the body were more accurate than those who saw only the face. While facial expression should be a fertile source of leakage because, as Darwin pointed out, it involves muscles most people cannot inhibit (the reliable muscles), our reasoning suggested that because people pay so much attention to each others' facial expressions, most people will attempt to tune their facial expressions when they lie. So, contrary to Darwin's prediction, the face should not be as good a source for observers as the body. An exception—an important one—is that micro expressions do leak information, but only keen observers can perceive it.

Now let us look at this matter from a different perspective, examining not what others can see (which is what the experiment described above did), but what is revealed when we use fine-grained measurements of how people behaved when they lied. Putting together Darwin's proposal and our elaboration, we should find micro expressions, squelched expressions, masked expressions, as well as leakage in body movements when the women lied.[c]

We measured the behavior shown in the videotapes of the women who had lied or been truthful about the emotions they were feeling.[3] The facial movements were measured with our Facial Action Coding System (FACS),[12,13] which identifies each and every facial muscular movement. We measured only one type of body movement, what we have termed *illustrators*[14]—hand movements that emphasize and otherwise illustrate simultaneous speech. The pitch of the voice was measured. Those who made these measurements of face, body, and voice did not know whether the interviews they scored were honest or deceptive and were unfamiliar with the purpose of the experiment.

[c]The relationship between these two approaches to assessing the information contained in expression is discussed at more length in ref. 51, chap. 2.

When the women attempted to conceal negative emotions, claiming to feel enjoyment, they showed more masking smiles—in which a smile (*zygomatic major* or AU 12 in FACS scoring) is superimposed over muscular actions associated with fear, sadness, or disgust—than they showed when they had truthfully described enjoyable feelings. Just the reverse was found with the type of smile that other evidence (described below) has identified as a sign of enjoyment (*zygomatic major* and *orbicularis oculi, pars lateralis* or 6+12). This type of smile was shown more often when the subjects honestly described enjoyable feelings than when they falsely claimed to have such feelings.[15] We did find micro expressions when some of the subjects lied, but only about a quarter of them showed these expressions. In later research studying other types of lies[16] we again found micro expressions, but only in some of our subjects.

Hand movements that illustrate speech decreased, as had been predicted; but the difference was only a trend, not reaching accepted levels of statistical significance. We noted that another type of body movement occurred only when people were lying—a fragment of a shrug gesture—but only by a third of our subjects. As with micro expressions, many of the signs of lying that we have identified are not shown by everyone. Their absence does not mean a person is truthful; but their presence, especially when there are multiple different types of signs (e.g., a fragment of a shrug and micro expressions), is suggestive. We also found that voice pitch became higher when the subjects lied.

Instead of only analyzing the average difference found across the entire group, we also considered how many of the subjects could be correctly identified by the behavioral measures. For illustrators it was possible to tell whether 38% were lying or truthful, 26% were misidentified, and it was not possible to classify 35%. Combining two smiling measures, we found that 48% were correctly identified, 16% were misidentified, and 35% could not be classified. The pitch measure accurately identified whether 59% of the subjects were lying or truthful, 16% were misidentified, and 31% could not be classified. Combining the facial measures and pitch slightly improved the discriminations: 61% correct, 10% incorrect, and 29% unclassified. Adding the illustrator measurement did improve accuracy.

It is too simple to say that there is more leakage in either the face or body. When people lie, there are both misleading signals and signals that betray the lie in both face and body. I will wait until the end of this chapter, after we have considered other types of facial behavior and other kinds of lying, to summarize which are the more reliable signals.

IDENTIFYING THE SMILE OF ENJOYMENT

The idea that actions that are difficult to make voluntarily will leak otherwise-concealed emotions (Darwin's inhibition hypothesis) is logically relat-

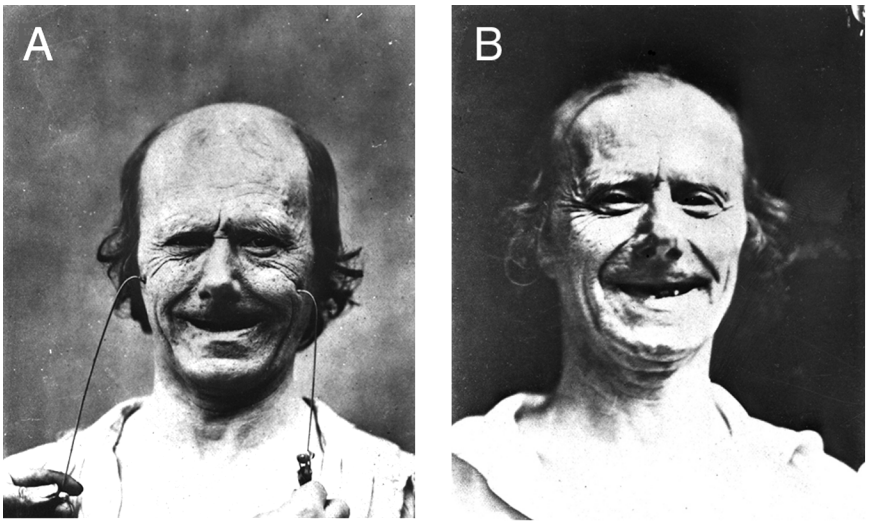

FIGURE 1. Photographs by Duchenne included in Darwin's *The Expression of the Emotions in Man and Animals*. (A) Smile produced when zygomatic major muscle was electrically stimulated. (B) Smile generated when subject was told a joke. The orbicularis oculi muscle was stimulated in addition to the zygomatic major.

ed to Duchenne's proposal about how to distinguish a smile of enjoyment from nonenjoyment smiling.[17] Duchenne compared the smile produced when he electrically stimulated the zygomatic major muscle (FIG. 1A) with a smile generated when he told the man a joke (FIG. 1B). The smile in response to a joke included not just the zygomatic major, but also the orbicularis oculi muscle (which orbits the eye, pulling the cheeks up, producing crow's feet, and slightly lowering the brows). Without orbicularis oculi, Duchenne said, "… no joy could be painted on the face truthfully … it is only brought into play by a genuinely agreeable emotion. Its inertia in smiling unmasks a false friend [p. 72]."[18] In agreement with Duchenne we found that most people cannot voluntarily make this action. Those who can do it usually cannot do so on both sides of their face simultaneously; although once they have produced it on each side of their face, they can hold the contraction on both sides.

Darwin included in his book the Duchenne photographs that appear in FIGURE 1. Darwin noted that the best sign that the muscle is not active is the failure of the eyebrows to lower slightly. This implies what we have found: that it is not the entire orbicularis oculi whose absence unmasks the false friend, only the outer portion of this muscle—what is called the orbicularis oculi, pars lateralis (AU 6).

In discussing the smile that lacks the orbicularis oculi, Duchenne said: "You cannot always exaggerate the significance of this kind of smile, which often is only a simple smile of politeness, just as it can cover a treason. …We

… politely smile with our lips at the same time as being malcontented or when the soul is sad" (pp. 127–128).[18] Darwin tested Duchenne's proposal by showing FIGURE 1 to observers. He reported that only FIGURE 1B, which includes the orbicularis oculi, was said to show happiness. In his honor I suggested that we call smiles incorporating the orbicularis oculi, pars lateralis *Duchenne's smile*.[19]

The failure to use Duchenne's distinction between smiles with and without the orbicularis oculi led to the mistaken conclusion that smiling is unrelated to emotion.[20–25] Even in recent years some investigators have failed to take the trouble to distinguish between Duchenne and non-Duchenne smiling. For example, Fridlund reported no relationship between smiling and self-reported happiness.[26] Yet we had reported earlier that Duchenne smiles were related to self-reported happiness, but total amount of smiling (Fridlund's measure) was not.[27] We also found that Duchenne smiles occurred more often when people watched amusing films as compared to gory films. Consistent with those findings Ekman, Davidson, and Friesen found that only Duchenne smiles distinguished which of two positive experiences subjects reported enjoying more.[19]

Currently, all those who studied deception (apart from our group) have continued to ignore Duchenne's distinction and have mistakenly concluded that smiling is unrelated to truthfulness. We were able to duplicate their failure when we used only a simple measure of total smiling; but, as I reported earlier in this chapter, when we separated Duchenne's smile from all other smiling, we were able to identify whether people were concealing strong negative emotions with a smile or actually enjoying themselves.[3,15]

In the last decade a number of studies have supported Duchenne's distinction. Fox and Davidson found more Duchenne smiles in 10-month-old infants when they were approached by their mother and more other forms of smiling when the infants were approached by a stranger.[28] When they combined Duchenne and non-Duchenne smiles, the differences between approach by mother and stranger disappeared. They also reported that only Duchenne smiles were associated with left frontal EEG activation, the pattern of cerebral activity repeatedly found in positive affect. This EEG pattern of cerebral activity was found in adults watching amusing films only when they simultaneously showed Duchenne smiles.[19] And when Ekman and Davidson selected subjects who could voluntarily contract the orbicularis oculi, pars lateralis (a minority of people) and asked them to make a Duchenne smile and a non-Duchenne smile, the EEG pattern of cerebral activity associated with enjoyment was generated only by their Duchenne smiles.[29] Many other studies by investigators in a number of countries have also found differences between the two forms of smiling (many are reported in Ekman & Rosenberg[30]).

Clearly, the distinction between Duchenne smiles and other forms of smiling based simply on the presence or absence of a muscle that most people

cannot activate voluntarily (the orbicularis oculi, pars medialis) is powerful. But, as I explained earlier, the fact that measurements reveal a difference does not tell us whether observers can see that difference when viewing expressions in real time. Frank, Ekman, and Friesen addressed this matter by asking observers to judge whether each smile they saw was a true, genuine expression of enjoyment or a false or social expression.[31] The smiles were drawn from two prior experiments, the one described earlier in which women lied or told the truth about how they felt[2] and a study in which subjects sat alone watching amusing or unpleasant films.[32] When the observers saw each smile one at a time, they were correct only 56% of the time, somewhat better than chance ($t(39) = 2.97$, $P < 0.01$). When they were shown two smiles of each person, one a Duchenne smile and one which was not, accuracy was significantly ($P < 0.0001$) higher, with a mean accuracy of 74% ($t(39) = 12.47$, $P < 0.001$). Neither condition—judging single smiles or judging pairs of smiles—very closely resembles real-life contexts, in which smiles are seen embedded in other behaviors, including speech, voice, and gesture. Nevertheless, this experiment does substantiate that Duchenne smiling can be recognized in real time.

The same video was used in another experiment, in which new groups of observers were asked not to say which smile was more genuine, but instead to fill out rating scales describing their impression of the persons they saw: for example, outgoing-inhibited, expressive-unexpressive, natural-awkward, likeable-unlikable. Frank *et al*.[31] combined the ratings on 15 such scales into an overall positive score. The ratings on this scale were more positive when the observers saw segments that contained a Duchenne smile as compared to segments that contained a non-Duchenne smile. This study shows that the type of smile observed influences global impressions even when attention is not directed to focus on smiling.

I believe these findings about the Duchenne smile can be extended to a wider set of emotional facial expressions. When emotional expressions lack a muscular movement that is difficult to make voluntarily, that expression should be less reliable; and those expressions that contain the reliable muscle should be more likely to be trustworthy. TABLE 1 shows that there is such a reliable muscle for sadness (Aus 1, 1+4 and 15), fear (Aus 1+2+4 and 20), and anger (AU 23) in addition to enjoyment. The research to check my proposal has yet to be done.

MICRO FACIAL EXPRESSIONS

Let us return to consider what we have learned about individual differences in the ability to identify a micro facial expression. We constructed a test by tachistoscopically presenting for 1/25 s photographs of very intense facial ex-

pressions.[33,34] Prior research had established that these expressions were easily recognized, with high agreement across cultures, when they were viewed for 10 seconds. As predicted on the basis of our observations that micro expressions appear in subjects when they are lying, accuracy on this tachistoscopic test was correlated with accuracy in identifying from videotapes which of 10 women were lying or telling the truth about their emotions ($r = 0.27$, $P < 0.02$). (We presume the correlation is not higher, because not all the women showed micro expressions).

In a second study we constructed a different test of the ability to identify facial expressions.[35] A different set of facial expressions that elicit high agreement across cultures[36] was shown tachistoscopically. Again, we found micro recognition accuracy correlated with deception judgment accuracy ($r = 0.34$, $P < 0.04$).

A potential limitation of testing the ability to recognize micro expressions with a tachistoscopic presentation of facial expressions is that, unlike real life, there is no preceding or following expression. To remedy this problem I produced a new test, which I called the Brief Affect Recognition Test (BART), in which a neutral image of a person is shown, followed by an emotional expression for 1/15 s, followed by the neutral image of that person once again. No afterimage lingers, as the neutral face follows immediately. Photographs of Caucasian and Japanese intense expressions, the JACFEE set, were used. Frank used 24 items from BART and found that accuracy on it correlated with accuracy in judging videos in which 18 people lied or told the truth about their beliefs on a controversial social issue.[37] This was so for both Australians ($n = 104$, $r = 0.19$, $P < 0.05$) and for Americans ($n = 34$, $r = .30$, $P < 0.05$) who took both tests.

Matsumoto *et al*. used a 56-item version of BART in five experiments.[38] They established that BART is reliable, both in terms of internal consistency and over time. They also found that accuracy was consistently, but modestly, correlated with the Openness score on the Big Five Inventory-54.[39] People who score high on Openness are considered to be more attentive and receptive to the environment and the people around them. Accuracy on BART was also correlated with Extraversion, but on only one of two personality tests (the Eyesenck, not the BFI).

I recently developed a version of BART that is intended to train people to improve accuracy in recognizing micro expressions. This Micro Expression Training Tool (METT) includes feedback about the correct answers, modified faces contrasting the most difficult-to-discriminate emotions, and a pre- and posttest.[40] Frank and I each separately provided this training and, in yet-to-be-published studies, obtained a very large increase in accuracy with less than one hour of training. Thus, it appears that while most people are not attuned to the recognition of micro expressions, most can learn to become sensitive to them. We do not yet know how long improvement gained through training is maintained.

ASYMMETRY IN EXPRESSION

Through serendipity we first found that spontaneous emotional expressions are more symmetrical than those made deliberately.[41]

> We noted in Sackeim, Gur and Saucy's report[42] about emotions being expressed more intensely on the left side of the face, that this effect was evident for all but the happy faces they evaluated. We had supplied Sackeim et al. with the faces and knew that only the happy ones were expressions of felt emotion, having occurred spontaneously as we joked with the models. We had produced all the other by asking our models to deliberately move a specified set of facial action units. … We reasoned that deliberately made facial expressions, such as false smiles, would require more cortical involvement and thereby be more likely to show asymmetry because of cerebral specialization, than uncontrolled, spontaneous, felt emotional expressions. Searching the literature on facial asymmetry we found support for this hypothesis in Lynn and Lynn's[43, 44] reports that asymmetries were rare for spontaneous smiles [p. 246].[45]

Ekman, Hager, and Friesen verified this difference in symmetry.[45] In one study they found that when children were asked to imitate facial movements, they produced asymmetrical facial actions; while the spontaneous smiles they showed during the task were symmetrical. The symmetry of the expressions shown by adults watching pleasant and unpleasant films was consistent with the children's results. Their smiles in response to watching an amusing film were nearly always (96%) symmetrical. Their expressions that included facial actions associated with negative emotions shown when watching unpleasant films were also for the most part symmetrical (75%).

Hager and Ekman extended the earlier findings by comparing the facial actions shown in response to a very loud noise (startle) with deliberately performed actions, and with a smile made in response to an amusing event.[46] Spontaneous smiles were more symmetrical than requested smiles. The action of the orbicularis oculi, pars lateralis (the sign of genuine enjoyment identified by Duchenne described earlier) was also more symmetrical when it accompanied a spontaneous smile as compared to when it was deliberately performed. Stretching the lips horizontally (AU 20) was more symmetrical when it occurred in response to the loud noise than when it was deliberately performed.[d]

[d]They had intended to compare the spontaneous reaction to the startling noise with a simulated startle, but when subjects simulated a startle they performed very different actions than those that had been shown spontaneously. They had also intended to compare spontaneous emotional reactions with posed emotions, but there were too few spontaneous actions to allow the comparison. When facial actions were asymmetrical, the side of the face in which the facial movement was stronger varied muscle by muscle, unrelated to the branch of the facial nerve that activates each muscle.

HOW LONG AN EXPRESSION LASTS

Ekman and Friesen found that spontaneous expressions usually lasted between 2/3 of a second and 4 seconds.[41] Their observation was limited to spontaneous smiles shown when subjects had watched pleasant films. Hess and Kleck replicated this observation, finding a difference in duration between spontaneous smiles and deliberately posed smiling.[47]

Frank *et al*. further confirmed this difference in duration, examining Duchenne smiles and non-Duchenne smiles shown in a sample of people watching a pleasant film and in a sample of people who described their feelings as they watched a pleasant film.[31] They found that there was less variability in the duration of Duchenne smiling and that most such smiles lasted, as predicted, between ½ and 4 seconds.[e]

SMOOTH EXPRESSIONS

Ekman and Friesen observed another difference in timing between spontaneous and deliberate expressions.[41] In deliberate expressions the onset is often abrupt, the apex (moments of maximum contraction) held too long, and the offset (the period from the apex to the disappearance of the expression) is either abrupt or in other ways appears irregular rather than smooth. Frank *et al*. confirmed these observations by contrasting the timing of Duchenne smiles and non-Duchenne smiles shown in subjects watching an amusing film alone and in subjects talking about their feelings as they watched an amusing film.[31]

CONCLUSION

There is no single source within demeanor that is completely trustworthy, impervious to efforts to disguise; nor is there a source that should be ignored because it is completely untrustworthy. Darwin rightly noted how easily "… words may be falsified." It is easy not only to falsify what is said but also to conceal information from speech; yet we have found repeatedly in studies with our experimental materials and in examining real-life cases that words themselves provide important clues that a person may be lying. It would be a mistake *not* to scrutinize very carefully what people say. Some of the verbal clues are topic specific—that is, are useful if they are not part of the person's usual behavioral repertoire but instead appear only when a specific topic is

[e]In the solitary condition the average smile was longer, but this was due to two outliers who produced very long smiles. Without those two subjects the findings conformed to the prediction.

discussed. Hesitations, changes in emphasis, speech errors, indirect or distancing language (e.g., "that woman") are all topic-specific clues. Other clues, such as slips of the tongue, implausible statements, contradictions between what is said at different times, and statements that can be incontrovertibly contradicted by other facts, stand on their own. Taking into account not only what a person says, but also the sound of the voice, the expression on the face, gesture, and posture is of critical importance.

Although I have not said much about them in this report, gestural slips—the equivalent of slips of the tongue—do occur in some people and are valuable sources of concealed information.[f] Because these are typically brief, involving only a fragment of the total gesture, most people do not see them unless they are alerted to the phenomenon. Even then, they miss gestural slips unless they know the vocabulary of gestures—what Efron and we (adopting Efron's terminology) called *emblems*.[14,48] Emblems are culture specific, just as language is, with emblems in one language group totally missing in another or having a different meaning in another language setting.

Micro facial expressions are a very useful sign of concealed emotions. They can be seen in real time with training. (The MicroExpression Training Tool[40] accomplishes this in a short time.) Some people we have found already see them without being trained, but there are not many such people. Much work remains to be done, such as to determine how long the effect of training lasts and whether or when refresher courses are needed. Even without that evidence, it would be wise, in my judgment, for those interviewing people in situations where emotions might be concealed to learn to detect these expressions. Elsewhere I have considered how to use the information revealed by micro expressions in the workplace, friendship, and family life.[49] In situations in which distinguishing lies from truthful statements is the focus, great care must be taken not to make either of two mistakes. First, the absence of micro expressions, like the absence of gestural slips, does not prove a person is truthful; not all liars show such signs.

The second mistake is to presume that concealed emotion is evidence that a person is lying about the topic of interest to the interviewer. We need to be careful to avoid what I have called Othello's error.[10] He mistakenly assumed that Desdemona's expression of fear was the reaction of a woman caught in betrayal. He failed to understand that emotions do not tell you their cause. The fear of being disbelieved looks the same as the fear of being caught. In real-life lies that I have studied people suspected of crimes sometimes show micro expressions of anger. Only through further questioning is it possible to determine whether the concealed anger is the result of being wrongfully under suspicion or whether it is anger toward the interviewer for trying to catch

[f] I have described how gestures may act like slips of the tongue, revealing concealed information, in my book *Telling Lies*.[10] In further research we have confirmed these findings through studying other subjects in other kinds of lies.

the suspect in a misdeed. Lying about the topic of interest should be the last, not the first, explanation of why a micro expression has occurred.

Although the bulk of the findings I have described in this chapter pertain to smiling, my expectation that findings apply to other emotional expressions has been supported by those studies that have examined other expressions. Apart from micro expressions, there are seven characteristics that will be of help in distinguishing voluntary from involuntary facial expressions:

(1) *Morphology.* This is best documented for enjoyment; but the absence of any of the reliable movements should raise questions about whether the expression is voluntary rather than involuntary, and the presence of the reliable actions should suggest that an expression is genuine.
(2) *Symmetry.* While tedious to measure, and not likely to be detectable in real time, asymmetry is a mark that the expression is deliberate.
(3) *Duration*. Very brief (<½ s) and very long (>5 s) duration of expression should occur more often with deliberate than spontaneous expressions.
(4) *Speed of onset.* Although this varies with social circumstances, the onset of a deliberate expression will more often be abrupt than that of a spontaneous expression.
(5) *Apex overlap*. In those expressions in which there are multiple independent facial actions, it is likely that the apexes of the actions will overlap if the expression is spontaneous. There has been no research on this suggestion.
(6) *Ballistic trajectory.* The expression will appear smooth over its trajectory, without a stepped or jagged offset, if it is spontaneous.
(7) *Cohesion*. The expression will fit with what is being said simultaneously.

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