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Was Darwin Wrong About Emotional Expressions?

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Abstract

Emotional expressions have endured as a topic of profound scientific interest for over a century, in part due to Darwin's classic volume, *The Expression of Emotions in Man and Animals*. Since its publication, there has been a strong, spirited debate over the origin, nature, and function of emotional expressions. In this article, I consider two basic questions: What did Darwin really write about emotional expressions, and how well does his account match the modern, conventional, "basic emotion" account? And does the scientific evidence specifically support the modern account of Darwin's view, or are there alternative hypotheses that provide good (or even better) interpretations for the data at hand? I discuss the various ways that Darwin might be correct (and incorrect) about how emotions and their manifestations have been sculpted by natural selection.

Keywords

Darwin, emotion, emotional expression

Charles Darwin is perhaps our most cherished scientist. His 1859 book *On the Origin of Species* caused a paradigm shift in the life sciences. Psychologists have been similarly compelled by Darwin's *The Expression of the Emotions in Man and Animals* (*The EEMA*; Darwin, 1872/2005). His view has been transformed into the theoretical foundation for the modern science of emotional expression, called the "basic emotion" approach, in which it is hypothesized that certain physical movements in the face and body are evolved adaptations that are biologically basic in their form and function. The Shariff and Tracy (2011) article in this issue is an excellent example of the basic-emotion approach, hypothesizing that certain facial actions (e.g., a startled, wide-eyed expression) evolved to express certain internal mental states (e.g., fear) and that humans are born able to automatically decode these expressions for their emotional meaning. In the Shariff and Tracy account, emotional expressions regulate the body to deal with the emotional situation (e.g., prepare to flee). Expressions also nonverbally signal important emotional information to others (e.g., there is danger here). This compelling narrative is the received view in the scientific study of emotion: Many scientific papers casually state that expressions are innate and universally recognized. Research findings are interpreted in support of this view without much consideration of alternative explanations. The view has been absorbed, without reflection, into other fields (e.g., cognitive neuroscience). But this intuitive and pleasing narrative is plagued by two nagging questions. First, is this story really Darwin's story, or is it an example of what Danziger (1997) calls "presentism"—reinterpreting the past so that it comes to look like a catalogue of anticipations of the state of things today? Second, does the scientific evidence specifically support this story, or are there alternative hypotheses that provide as good (or even better) interpretations of the data at hand?

What Darwin Really Said About Emotional Expressions

Darwin, like several of his contemporaries in mental philosophy, believed that a state of mind causes muscular discharge (such as coordinated sets of facial muscle contractions) that expresses said state of mind. According to Darwin, some of these expressions are true instinctual reflexes whereas others are result of learned association or habit. According to most basic-emotion accounts, Darwin also supposedly claimed that expressions were *functional adaptations*. But did he?

The EEMA was Darwin's attempt to bolster his hypotheses about natural selection.[1] Not every product of natural selection is functional, however; an inherited feature could be vestigial and useless, like a tailbone. In fact, vestiges can be an even stronger proof of concept for natural selection than are useful adaptations, because they persist *despite* having no function. Darwin recognized this when he wrote about emotional expressions. He described them as once-useful habitual gestures that were long ago performed willingly and voluntarily;

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upon becoming associated with emotion after long practice, they continue to occur with emotion even when those expressions are *no longer functional*. In describing his "principle of serviceable associated habits," for example, Darwin wrote, "whenever the same state of mind is induced, however feebly, there is a tendency through the force of habit and association for the same movements to be performed though *they may not then be of the least use*" (1872/2005, p. 19, italics added). In his "principle of antithesis," Darwin again mentions the uselessness of emotional expressions: "when a directly opposite state of mind is induced, there is a strong and involuntary tendency to the performance of movements of a directly opposite nature, though *these are of no use*" (again, p. 19, italics added). He also mentions their lack of usefulness when he described his "principle of direct action," in which unlearned and nonhabitual physical states issue from the structure of a creature's nervous system (e.g., pp. 39 and 44). In fact, Darwin described expressions as vestigial throughout his book (e.g., pp. 25, 27, 30, 32, 39, 46 and 187). (He did admit, on pages 27 and 30, that expressions may be of some service under certain circumstances, but he did not elaborate on what that service might be.) It was, in fact, Floyd Allport (1924) who wrote extensively on Darwin's ideas and inferred that emotional expressions must have some adaptive function (see text beginning on p. 211). These observations are more than historical footnotes—Darwin's name has scientific authority that (however unintentionally) gives a certain authenticity and validity to the basic-emotion view. As a result, researchers will be more likely to anchor on an idea from Darwin and adjust away from it, in effect treating Darwin's view as the null hypothesis to be proved wrong. In this respect, it is important to be clear about what Darwin did or did not say.

In another writer's hands, the transformation of Darwin's past writings into present hypotheses might have looked very different. For example, Darwin wrote that humans are active perceivers who do not passively decode expressions, implying that humans might not have preserved, evolved mechanisms for extracting information from expressions. *The EEMA* also states that expectations and context color perceptions of facial actions (e.g., pp. 11 and 12). Darwin also wrote that there is both within-category variability (a given emotion can be expressed in many different ways) and between-category similarity (very different emotions can have almost identical expressions; e.g., see pp. 74–75).[2] Although he did not expand on these ideas at great length, their appearance is notable because they are consistent with recent evidence and theory (e.g., Barrett, 2009; Barrett, Mesquita, & Gendron, 2011; Fox, Moon, Iaria, & Barton, 2009; Roberson, Damjanovic, & Kikutani, 2010; Russell, Bachorwoski, & Fernandez-Dols, 2003).

What the Evidence Really Says About Emotional Expressions

Regardless of what Darwin did or did not write, a more pressing question is whether the basic-emotion story of emotional expressions is correct, judged by the usual criteria to establish validity in science. Accordingly, there are three points where empirical evidence is relevant: (a) Expressions are supposed to coordinate or regulate "suites" of behavioral, physiological, experiential, and (sometimes) cognitive processes, but is there any evidence that such coordinated suites exist? And (b) are facial actions during emotion sufficiently consistent and specific so that they can (c) be recognized as expressions? For almost every "fact" that has been learned about emotion and expressions to answer these questions in the affirmative, a conflicting interpretation is scientifically viable (see Sidebar).

Are emotions coordinated suites of response? Every moment of waking life involves some coordinated change in physiology, action (or action tendency), feeling, and thought (not to mention sensory input from the world). Emotions are not special in this regard. The real question is whether the coordinated changes are sufficiently consistent for and specific to an emotion category that the pattern can define that emotion or diagnose its presence. The alternative view is that coordinated changes arise in sufficient variety (as James wrote in 1890[3]) that they cannot be used to define the boundaries of each emotion category, nor can they be used to objectively distinguish one emotion from another. Certainly there are individual studies that support the hypothesis that different emotions are associated with diagnostic responses, but how do we make sense of them in the context of persistent empirical reviews that present disconfirming evidence, calling into question the existence of specific emotional suites (in chronological order: Hunt, 1941; Mandler, 1975; Ortony & Turner, 1990; Cacioppo, Berntson, Larsen, Poehlmann, & Ito, 2000; Russell, 2003; Barrett, 2006a; Barrett, Lindquist, Bliss-Moreau, et al., 2007; Kagan, 2007; Mauss & Robinson, 2009; Lindquist, Wager, Kober, Bliss-Moreau, & Barrett, in press)? These reviews do not make the bold claim that emotions are illusions. Instead, they make the more nuanced claim that emotion categories do not have firm boundaries in nature (i.e., emotions are not natural kinds). They demonstrate that behavioral, physiological, experiential and cognitive responses are highly variable within an emotion category, and this variability can be observed even in experiments explicitly designed to produce stereotypical emotional responses. Collectively, the empirical evidence points to the need to explain this observable variability in emotional responding while at the same time understand how human perceivers deal with that variability and experience or perceive discrete categories of emotion (Barrett, 2006b). Do the relatively few positive results come from methodologically superior experiments that float to the top in a sea of misguided empirical attempts? Or does highlighting those studies, while ignoring all the contrary evidence, constitute a case of confirmatory bias?[4]

Do prototypic emotional expressions exist? Even if consistent and specific coordinated suites are finally discovered, the next question is whether "prototypic" facial expressions are consistently and specifically part of that suite (so that they help create or regulate emotional responses). That is, do the facial

Sidebar: Examples of Alternative Explanations in Emotion Research

Lab-reared rhesus monkeys develop a "fear response" after seeing wild rhesus monkeys display a similar response to snakes. This might be an evolved preparedness for fear of snakes (Ohman & Mineka, 2001), but it might also be understood in the same way that superstitious behaviors are learned, especially since many wild rhesus monkeys do not naturally show fear of snakes (Bravo et al., 2010).

Avoidant motor behaviors could be facilitated by viewing a facial depiction of fear, while approach motor behaviors are facilitated by facial depictions of anger (Wilkowski & Meier, 2010), because humans have learned the symbolic meaning of these facial actions in the context of scripts for anger and fear. One possibility is that there is a biological imperative to avoid in fear or approach in anger; another possibility is that people perform these behaviors because they have learned the culturally appropriate scripts for fear and anger.

Is fear "a cascade of responses including heavier breathing, the redistribution of blood to limb muscles to prepare for rapid movement" (Shariff & Tracy, 2011, p. 396), even though a meta-analytic summary of the psychophysiological literature does not bear this out (Cacioppo et al., 2000), or is this the pattern of psychophysiological responding for a motivated state of "challenge" (Blascovich & Mendes, 2010)?

Congenitally blind individuals might be able to display pride expressions because of an innate need to communicate social status (Shariff & Tracy, 2011), but another interpretation is that emotion concepts can be learned from other forms of communication. Consider that congenitally blind individuals, along with people who are color blind, produce a color wheel that is similar to normally sighted people when they are asked to make similarity judgments of words (Shepard & Cooper, 1992). To the extent that emotion concepts are embodied and can be used for perceptual inferences and action regulation (hypothesized by Barrett, 2006b), these findings might be taken as evidence for the power of social learning about emotion.

If there are early event-related potential (ERP) signal or blood oxygen level dependent (BOLD) response differences to fearful versus neutral faces, can we claim that we have found the neural signature for fear, or is the brain processing another psychological property, such as salience or novelty? When we compare the neural correlates for smiling versus pouting faces, does this reveal something about happy versus sad expressions (as basic emotions) or a difference in hedonic valence (that would be observed for all pleasant vs. unpleasant faces)? When we compare the neural correlates for pouting versus scowling faces, do the results reveal something about sad versus angry expressions or a difference in affective arousal?

Chimpanzees are able distinguish a negative face (e.g., "bared teeth") from a neutral face but have difficulty distinguishing one negative face from another (e.g., a "bared teeth face" and a "scream face"; Parr, Hopkins, & de Waal, 1998). Rhesus macaque monkeys also have the greatest success differentiating between a positive face (i.e., "play face") and either a neutral or negative face but have difficulty telling one negative face from another (Parr & Heintz, 2009). One possibility is that nonhuman primates perceive expressions that are supposed to be indicative of discrete emotions, but another interpretation of the same evidence is that they perceive affective valence.

caricatures that depict each emotion most clearly in a Western cultural context (and that are used unquestioningly in scientific research) actually represent the facial actions produced by human emoters in everyday life? Do people routinely (or *ritually* to use Shariff & Tracy's term) pout in sadness, scowl in anger, wrinkle their nose in disgust, and widen their eyes in fear? Certainly these exaggerated posed faces are *symbols* of emotion, but are they *signals* that represent the state of the emoter and even diagnostic features of the situation (as hypothesized by Shariff & Tracy, 2011, this issue)? If certain sets of facial actions are routinely produced when expected and are absent when they should be, then it makes sense that they should be displayed in the exaggerated, visually obvious ways now used in experiments. But if they are not typical of the facial actions that occur during episodes of emotion (and if they are frequently produced when no other signs of emotion are present), then *we (scientists) have created a science of emotional symbols* by routinely using them in experiments. The fact that perceivers differentially scan these faces (Smith, Cottrell, Gosselin, & Schyns, 2005) or that these facial actions change how expressors sample smells and sights (e.g., Chapman, Kim, Susskind, & Anderson, 2009; Susskind et al., 2008) becomes important to the nature of emotion only if people typically produce these facial actions when emoting (otherwise, those findings are still important but do not necessarily reveal anything about emotion specifically).[5]

Perhaps surprisingly, the crucial question of whether the prototypic faces are typical (i.e., do people actually make these faces in emotion?) is still without a solid empirical answer, and so far, the data are not encouraging. Laboratory studies using objective measures of facial-muscle actions (e.g., facial electromyography) do not find evidence that these facial expressions emerge during emotional episodes (see Cacioppo et al., 2000; Russell, Bachorwoski, & Fernandez-Dols, 2003).[6] For example, congenitally blind infants (Fraiberg, 1977), children (Roch-Levecq, 2006), and adults (Galati, Scherer, & Ricci-Bitti, 1997) produce only a limited number of the predicted facial actions when displaying emotion and almost never produce an entire configuration of facial-action units; but then, neither do sighted people (again see Galati et al., 1997). This is also the case with spontaneous facial actions (Galati, Miceli, & Sini, 2001). Even 4-month-olds do not produce specific facial displays for anger, fear, disgust, and sadness (e.g., Bennett, Bendersky, & Lewis, 2002; for a review, see Camras & Fatani, 2008). Of course, there is an oft-cited claim that these expressions are regularly observed ethologically, but the replicability of those findings is still largely unknown. In addition, the ethology findings relied on human perceivers to indicate whether an expression was present or not, and given the expectations and contextual influences that Darwin wrote about (and that we know to exist during emotion perception; Barrett et al., 2011), it is important to back up such claims with more "objective" (i.e., perceiver-independent) observations. It is not clear whether researchers

have tried to collect such evidence and failed or whether the typicality question is not yet a topic of scientific interest. Either way, this sort of documentation seems crucial.

One innovative suggestion by Shariff and Tracy (2011) is that exaggerated expressions occur primarily in response to "recurrent environmental events that pose fitness challenges," particularly for communication purposes. This hypothesis, if supported, would imply that certain facial actions (e.g., startled, wide-eyed actions) are not signals of emotion (e.g., fear) in every instance but only when information is needed for social communication (coming close to the hypothesis offered by Fridlund, 1991).[7]

Are facial actions recognized as emotional expressions? The classic cross-cultural studies of emotional expressions found that people of other (sometimes non-Western) cultural contexts can "recognize" posed, caricatured portrayals of expressions (meaning, they could identify the emotion that was intended by the experimenter). This is a very important finding, but perceivers across cultures could have just as easily been correctly identifying a symbol (rather than "recognizing" an innate signal that people typically make in real life). Furthermore, the fact that a cross-culturally stable feature exists (like perceiving a scowling face as angry) does not necessarily imply that the feature evolved in its current form. Consider that all cultures have a religious, magical, or mystic role that serves an important social function; we would not say this role was directly inherited and innate. The fact that the different cultures see emotional meaning in the face is evidence that something evolved, but the question is what? Maybe it was the ability to recognize emotional expressions, but an equally plausible interpretation is that these findings give evidence for the evolved nature of the intentional stance (the tendency to attribute psychological meaning to moving bodies); certainly the fact that people easily perceive emotions in moving squares and triangles (Heider & Simmel, 1944) is consistent with this hypothesis, as is decades of research in the person-perception literature (for a discussion, see Barrett, 2006b). Since this is the case, then emotional expressions might be more like chins than like tailbones—the chin is not a morphological feature of the face that is adaptive; it is a perceived feature of the face that arises from more basic parts (i.e., bones that are changing under differential selection pressures). In this sense, facial expressions could be "spandrels," or secondary phenomena that did not evolve directly but instead resulted from a combination of other parts that did; Gould & Lewontin, 1979; cf. Barrett, 2006c).

These cross-cultural studies of emotion perception also contain methodological features that provide alternative explanations for the degree of cross-cultural stability they find (Russell, 1994). In a typical experiment, researchers present perceivers with a static face posing an emotion and a list of emotion words (typically six, but as few as two), and perceivers are asked to choose the word that best matches the face. Small changes in the experimental procedure (using spontaneous expressions; Naab & Russell, 2007; or decreasing the accessibility of emotion words during the task; e.g., Lindquist, Barrett, Bliss-Moreau & Russell, 2006) significantly reduce judgment accuracy. Perhaps what has evolved is not the signal value of facial actions but the use of emotion words to structure the perception of emotion in faces (and other body parts) that are continuously moving and difficult to interpret (Barrett, Lindquist, & Gendron, 2007). It is problematic to claim, as Shariff & Tracy do, that cross-cultural studies offer "the strongest pieces of evidence for an underlying human nature" (2011, p. 395) when the exact outcomes produced by these experiments can be reduced dramatically in a sample of homogenous American undergraduates just by modifying some methodological factors. In the context of such findings, it is important to note that 17-week-olds (Caron, Caron, & Myers, 1985) and elderly people (Isaacowitz et al., 2007) in a Western cultural context have difficulties recognizing posed facial depictions of emotion.

Summary

Darwin was surely correct that emotions are, in some sense, the product of natural selection. Evolution is a real phenomenon, and natural selection is a powerful force. The architecture of the human mind was surely sculpted by important evolutionary factors, although perhaps in ways other than those proposed by the basic-emotion view. Its blueprint for evolved mechanisms is intuitive, but strong intuitions do not make something true. Given what we now know about brain evolution, it is highly unlikely that each emotion emerged as its own mechanism, with its own selection pressures, along its own evolutionary path (cf. Barrett, Lindquist, Bliss-Moreau, et al., 2007).[8] It is inefficient to evolve a unique solution for every contingency. Instead, it is more likely that evolution produced a generative, multipurpose set of mechanisms that work together in each instance to produce a variety of emotional responses that are exquisitely tailored to each situation (Barrett, 2006b). We do not know which view is correct, or if there is some other, better view to account for the data we have, but studies designed to permit strong inference are required to know just what it is that has evolved to produce the emotions that scientists experience and perceive each and every day.

What about some of the details in *The EEMA*? Does a fearful person look startled—eyes wide, mouth agape, and eyebrows raised? Does an angry person scowl—brows furrowed, eyes glowering, and jaw tightened? Does a sad person frown—lips pouting, brows pulled together? Are emotions innately written on the face as a particular arrangement of facial actions for all the world to decode? Based on the available evidence, some scientists would answer yes, while others would say no. Most agree that evidence is, at best, mixed—where people disagree is on how to interpret such mixed evidence. So the real answer is: We just do not know yet. Perhaps as a field we should admit this, and at least for the moment, stop making declarations that would be better phrased as hypotheses.

Ironically, if humans do not make prototypic expressions on a routine basis (even in challenging environmental

contexts), then Darwin still might have been right about one thing when it comes to expressions: their lack of signal value. That these expressions appear routinely in North American children's books, cartoons, and B movies—and in laboratory experiments—might attest to their symbolic, rather than their signal, value. Emotional expressions might be learned and, like other symbol-based communication that is socially learned, this would be evolutionary significant, immediately functional in individual instances, and adaptive for a species. That perceivers automatically encode the context during emotion perception (Barrett et al., 2011) might reveal something about the more general, evolved mechanisms that humans use to perceive intentions in each other.

Recommended Reading

Barrett, L. F. (2006a). (See References). Reviews published evidence that is inconsistent with the hypothesis that emotions are natural-kind categories.

Barrett, L. F., Mesquita, B., & Gendron, M. (2011). (See References). Reviews recent evidence on context effects in emotion perception.

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Russell, J. A. (1994). Is there universal recognition of emotion from facial expression? A review of the cross-cultural studies. *Psychological Bulletin, 115*, 102–141. Reviews alternative explanations for the cross-cultural findings that support a basic-emotion view of emotion perception.

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Notes

1. In part, Darwin wrote the *EEMA* in response to Charles Bell's creationist account of emotional expressions.

2. Darwin's descriptions of emotional expressions deserve a close reading, not only because some of them contradict (or are omitted from) the traditional basic-emotion account but also because they provide intriguing insights into his thinking. For example, he wrote that hair becomes erect in anger (p. 67) and in terror (p. 79). He also wrote that kinky hair (i.e., permanently erect) is a sign of insanity (p. 160). This is such an obvious example of the representativeness heuristic (that causes and effects resemble each other), as is the claim that buzzing insects express anger and fear (pp.13–14), that one can be forgiven the temptation to view all of Darwin's descriptions of expressive similarities in this light.

3. Like Charles Darwin, William James is another misquoted historical figure in the field of emotion. James wrote against the view that different categories of emotions are entities with distinct biological signatures, but the attempts to integrate his view with Carl Lange (who believed that emotions had vasomotor essences) have led writers to mistakenly assume that James was a basic-emotion theorist.

4. It is not enough to show that an emotion is associated with any change in the face or body or brain (e.g., Lench, Flores, & Bench, 2011; Vytal & Hamann, 2010)—the changes have to be consistent for and specific to each category, and of a form that can be inherited. This is not a straw-man argument—it is a tenet of the basic-emotion approach. The question for the field is whether any pattern of findings is replicable and specific enough to give evidence of a diagnostic signature for each emotion, providing evidence that there are biologically basic states that have been inherited and can be expressed.

5. Widened eyes might afford an expanded visual field, but one cannot claim that fear invariantly affords this function until it is convincingly shown that people (a) routinely widen their eyes in fear and (b) are feeling fear when they widen their eyes. If people widen their eyes in surprise or to emphasize a point during an argument, implying that fear is not the only mental state that affords greater visual sampling, then can we claim that fear specifically evolved for this purpose?

6. The Facial Action Coding System (FACS) is a perceiver-based coding system that is less objective than facial electromyography (which does not require a perceiver) but perhaps more objective than global judgments of emotion. It is an open question whether studies using FACS find the sort of consistent and specific evidence that would convincingly demonstrate the existence of prototypic facial expressions. An encouraging review can be found in Matsumoto, Keltner, Shiota, Frank, and O'Sullivan (2008), although that chapter does not include a serious discussion of disconfirming evidence.

7. Even if expressions cause changes in nervous system responses, I am not sure this is always equivalent to regulation. Every time I stand from a sitting position, my heart beats faster (so I will not faint), but we would not say that I am regulating my heart by standing.

8. Behavioral adaptations like freezing, fleeing, and fighting might have their own mechanisms, but these do not have a one-to-one correspondence with emotion categories.

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