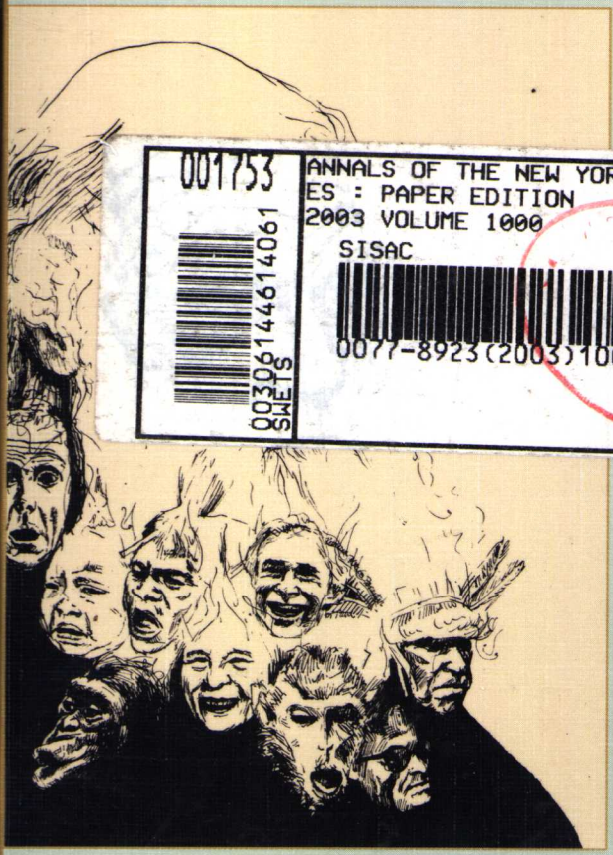
Emotions Inside Out

130 Years after Darwin's *The Expression of the Emotions in Man and Animals*



Editors
Paul Ekman
Joseph J. Campos
Richard J. Davidson
Frans B. M. de Waal

ANNALS OF THE NEW YORK ACADEMY OF SCIENCES VOLUME 1000

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The New York Academy of Sciences
New York, New York
2003

Library of Congress Cataloging-in-Publication Data

Emotions inside out: 130 Years after Darwin's *The Expression of the Emotions in Man and Animals* / edited by Paul Ekman ... [et al.].
p. cm. — (Annals of the New York Academy of Sciences ; v. 1000)
Result of a conference sponsored by the New York Academy of Sciences and held November 16–17, 2002 in New York City.
Includes bibliographical references (p.).
ISBN 1-57331-464-1 (cloth : alk. paper) — ISBN 1-57331-465-X (pbk. : alk. paper)
1. Darwin, Charles, 1809–1882. Expression of the emotions in man and animals—Congresses. 2. Emotions—Congresses. 3. Expression—Congresses. 4. Psychology, Comparative—Congresses. I. Ekman, Paul. II. Series.
Q11.N5 vol. 1000
[QP410]
500 s—dc22
[152

2003023320

GYAT / PCP
Printed in the United States of America
ISBN 1-57331-464-1 (cloth)
ISBN 1-57331-465-X (paper)
ISSN 0077-8923

ANNALS OF THE NEW YORK ACADEMY OF SCIENCES

Volume 1000
December 2003

EMOTIONS INSIDE OUT

130 Years after Darwin's *The Expression of the Emotions in Man and Animals*

Editors and Conference Organizers
PAUL EKMAN, JOSEPH J. CAMPOS, RICHARD J. DAVIDSON, AND FRANS B. M. DE WAAL

This volume is the result of a conference entitled **Emotions Inside Out: 130 Years after Darwin's *The Expression of the Emotions in Man and Animals***, which was sponsored by the New York Academy of Sciences and held November 16–17, 2002 in New York City.

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Introduction

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ABSTRACT: **In *The Expression of Emotions in Man and Animals* Darwin argued that emotions are not unique to humans, but can be found in many species; that many of the same social occasions that generate emotions in humans do so in other animals. He asked why this particular expression for a particular emotion, and his answer formed part of his demonstration of the continuity of the species and was thus crucial to his evolutionary theory. Darwin was one of the first scientists to use photographs as illustrations and to use the judgment method for studying the signal value of an expression—which has become the most frequently used method in the psychology of expression. The contents of the present volume extend, support, and sometimes contradict Darwin's remarkable contribution to the field of the expression of emotions.**

KEYWORDS: **Charles Darwin; emotions; expression of emotions; judgment method**

We celebrate the 130th anniversary of the publication of Charles Darwin's book *The Expression of Emotions in Man and Animals* in this volume. It was published 13 years after *The Origin of Species* and one year after *The Descent of Man*. He originally intended *Expression* to be a chapter in *Descent*, but it grew too long. He began keeping the notes that formed the basis of this book in the 1830s.

It is an extraordinary book, radical for his time and for today. The only evidence that he gathered directly was the answers to a series of questions he sent to world travelers asking them about the expressions they observed for different emotions. His analysis of their replies suggested that expressions are universal, which is what is to be expected if there is a common descent. In itself this evidence did not support his explanation of the origins of mankind, for if we had all descended from Adam and Eve, we would have had the same expressions. What it did do, which he pointed out quite explicitly, was chal-

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Ann. N.Y. Acad. Sci. 1000: 1–6 (2003).
doi: 10.1196/annals.1280.002

lenge the racist theories of his day that claimed that Europeans were descended from a more advanced progenitor than the progenitors of Africans. By showing a common descent Darwin affirmed, in his words, "the unity of mankind."

Darwin argued that emotions are not unique to humans, but can be found in many species. Even bees get angry, Darwin said. It is only in recent years that those studying animal behavior have stopped shying away from the danger of anthropomorphism to recognize Darwin's wise observations that many of the same social occasions that generate emotions in humans do so in other animals.

Darwin asked a question that few before or after him have asked. Not just what expression occurs, not just when an expression occurs—although he did address these questions, he also asked why this particular expression for a particular emotion. His demonstration of the continuity of the species—that emotions are not unique to humans—which was crucial to his evolutionary theory, came from his answer to the "why this expression?" question.

He described three explanatory principles. According to the principle of *serviceable habits*, actions that originally had some usefulness would be preserved as signals. The retraction of the upper lip in a canine, exposing teeth preparatory for biting, was preserved as a display (in current terms) of the size of the weapon that might be used. In similar fashion the dog stands erect, hair on it's back upright to appear large, and thus threatening. (The concepts of *ritualization* and *intention movements* are terms current in ethology related to this principle). To explain why the dog slinks, with back down and close to the ground when affectionate or submissive, Darwin invoked his principle of *antithesis*. This stance occurs because it is the opposite of the movements for aggression. Darwin showed that these two principles applied equally to explaining the stance of an aggressive man (serviceable habits) as compared to the helpless man shrugging (antithesis) (see FIG. 1) For expressions that could not be explained by either of these two principles, Darwin invoked the principle of *direct action of the nervous system.*

His book is also a compendium of fascinating observations about the expressions of humans and other animals. We purse our lips when we concentrate on doing something, such as threading a needle. We open our mouth when listening intently. We want to touch with our faces those we love. We can bite affectionately, as do other animals. And so on, almost endlessly.

Darwin was one of the very first scientists to use photographs as illustrations, commenting in the introduction to his book how important it was to show exactly the details of expression. He was also the first scientist to use what has since become the most common method for studying the signal value of an expression—what is today called the *judgment* method. Darwin showed pictures, taken by the great French neurologist Duchenne du Boulogne[1,2] (who had published a study 10 years earlier on the anatomy of facial movement), to people and asked them what emotion was depicted.

Darwin wrote about his findings on the picture reproduced in FIGURE 2:

> One half of the face is made, by galvanizing the proper muscles, to smile; whilst the other half is made to begin crying. Almost all those (viz. nineteen out of twenty one persons) to whom I showed the smiling half of the face instantly recognized the expression: but, with respect to the other half, only six persons out of twenty one recognized it—that is, if we accept such terms as grief, misery annoyance as correct, whereas fifteen persons were ludicrously mistaken; some of

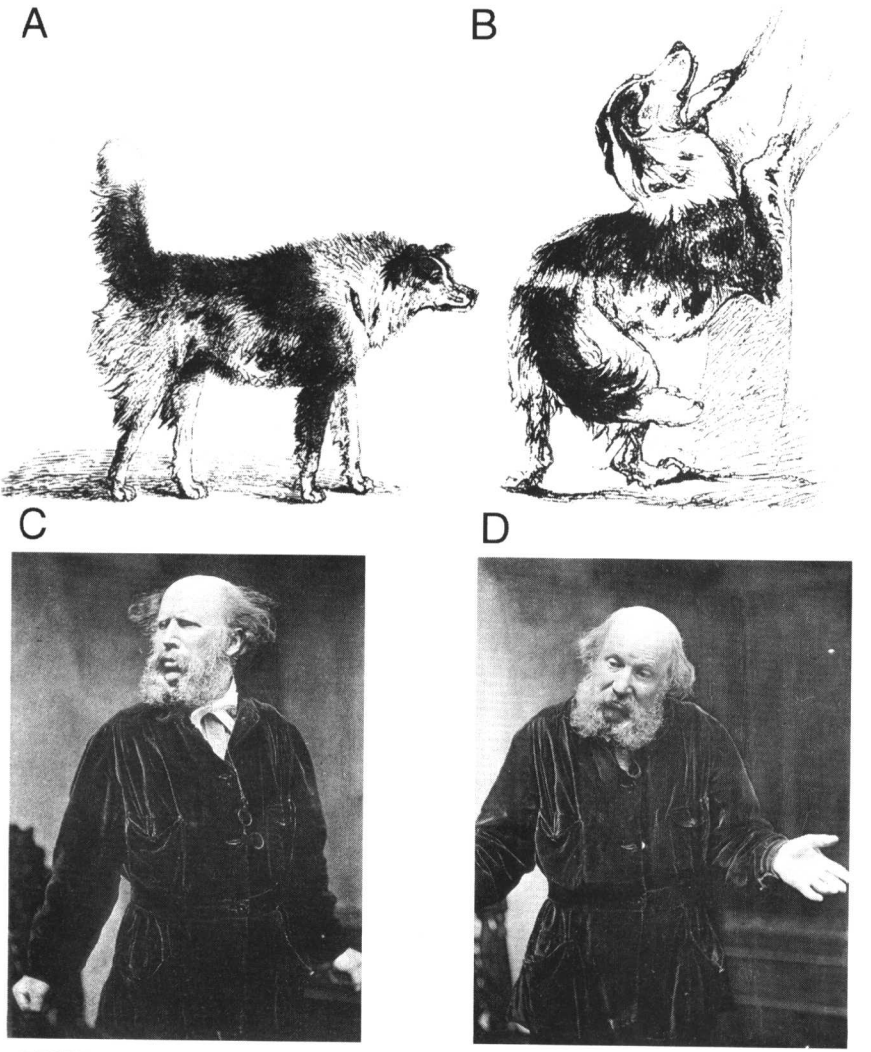

FIGURE 1. Darwin's illustrations of an aggressive **(A)** and a submissive **(B)** dog and an aggressive **(C)** and a helpless man **(D)**.[3]

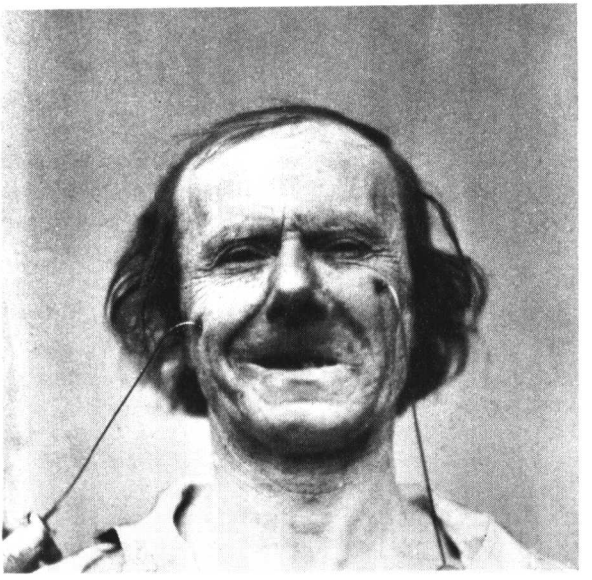

FIGURE 2. Darwin's illustration of a half-smiling, half-crying face used to elicit responses of observers.[3]

> them saying the face expressed fun, satisfaction, cunning, disgust, etc. We may infer from this there is something wrong in the expression. Some of the fifteen persons may, however, have been partly misled by not expecting to see an old man crying, and by tears not being secreted [p. 151].[3]

This method—showing pictures and studying the responses of those who observe them, the emotions they attribute to them—has become the most frequently used method in the psychology of expression.

Darwin was an extraordinarily attentive observer, and he attempted to explain every observation. For example:

> I believe ... that the depressor muscles of the angles of the mouth are less under the separate control of the will than the adjoining muscles; so that if a young child is only doubtfully inclined to cry, this muscle is generally the first to contract, and is the last to cease contracting. When older children commence crying, the muscles which run to the upper lip are often the first to contract; and this may perhaps be due to older children not having so strong a tendency to scream loudly; and consequently to keep their mouths widely open; so that the above named depressor muscles are not brought into such strong action [p. 153].[3]

This attention to description and explanation was, Darwin felt, his chief virtue. In his autobiography he wrote:

> I have no great quickness of apprehension or wit ... my power to follow a long and purely abstract train of thought is very limited ... [but] I am superior to the common run of men in noticing things which easily escape attention, and in observing them carefully [p. 141].[4]

He wrote with clarity and eloquence. Considering whether we need to learn to recognize emotions in others, or whether that ability is inborn, Darwin wrote:

> I attended to this point in my first-born, who could not have learnt anything by associating with other children, and I was convinced that he understood a smile and received pleasure from seeing one, answering it by another, at much too early an age to have learnt anything by experience. When this child was about four months old, I made in his presence many odd noises and strange grimaces, and tried to look savage; but the noise, if not too loud, as well as the grimaces, were all taken as good jokes; and I attributed this at the time to their being preceded by smiles. When five months old, he seemed to understand a compassionate expression and tone of voice. When a few days over six months old, his nurse pretended to cry, and I saw that his face instantly assumed a melancholy expression, with the corners of the mouth strongly depressed; now this child could rarely have seen any other child crying, and never a grown up person crying, and I should doubt whether at so early an age he could have reasoned on the subject [pp. 353–354].[3]

Darwin used an amazingly large array of data sources, unequalled even today. He observed humans in England and gathered observations of human expressions in other cultures from world travelers. He reported his observations of the animals in the London zoo and of domestic animals. He provided information on early development, drawing primarily on observations of his own large family. He inspected photographs supplied to him of the mentally ill. And he utilized what little was known about the nervous system and emotions to make some interesting speculations.

The contents of this volume, and the meeting on which it is based, reflect the breadth of Darwin's concern. Outstanding scientists in each of four areas report on their own work and recent work by others. First are three chapters on emotion and development, from a session organized and chaired by Joseph Campos; then three chapters on emotion in animals, from a session organized by Frans De Waal; then three chapters on expression, from a session organized by myself; and finally, three chapters on the physiology of emotion, from a session organized by Richard J. Davidson. Each of these sections is concluded by the highlights of the discussion that followed its three presentations.

This book captures the resurgence of interest in emotion. In each chapter you will read about work that extends, supports, and sometimes contradicts Darwin—each standing on the contribution made by this great man in his great book published 130 years ago.

ACKNOWLEDGMENTS

I am grateful to Rashid Shaikh, Director of Programs at the New York Academy of Sciences. When I suggested to him that there be a meeting and then a book to celebrate the 130th anniversary of the publication of Charles Darwin's *The Expression of Emotion in Man and Animals*, he was very encouraging. He endorsed my proposal that there should be four sections to represent the major areas of current research—expression, development, animal behavior, and physiology—that relate to Darwin's ideas. Throughout the planning, I received helpful advice from him about the structure of the program, which is represented in this volume.

I am also grateful for the advice and work of the three panel chairmen, whom I invited to organize the sections on development, animal behavior, and physiology—Joe Campos, Frans de Waals, and Richie Davidson, respectively. They each are leaders in their fields, and they invited for their panels outstanding scientists to cover different exciting work in their respective areas. Special thanks to Joe Campos, who managed this work while dealing with major visual problems. Each of the panel chairmen, who are coeditors of this volume, provided essential advice about the organization of the meeting and took responsibility for editing the panel discussions for their sectors.

Of course, Darwin is the man to whom we all owe a debt of gratitude. He began the field and provided lucid insights, the great majority of which have been borne out in what is reported in this book.

REFERENCES

1. DUCHENNE DE BOLOGNE, G.-B. 1862. Mécanisme de la Physionomie Humaine. Jules Renouard Libraire. Paris.
2. DUCHENNE DE BOULOGNE, G.B. 1990. The Mechanism of Human Facial Expression. A. Cuthbertson, Trans. & Ed. Cambridge Universitiy Press. New York.
3. DARWIN, C. 1998. The Expression of the Emotions in Man and Animals, 3rd edit. Harper Collins. London. (US edit.: Oxford University Press. New York.)
4. DARWIN, C. 1969. The Autobiography of Charles Darwin. W.W. Norton. New York.

Darwin's Legacy and the Study of Primate Visual Communication

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ABSTRACT: **After Charles Darwin's *The Expression of the Emotions in Man and Animals*, published in 1872, we had to wait 60 years before the theme of animal expressions was picked up by another astute observer. In 1935, Nadezhda Ladygina-Kohts published a detailed comparison of the expressive behavior of a juvenile chimpanzee and of her own child. After Kohts, we had to wait until the 1960s for modern ethological analyses of primate facial and gestural communication. Again, the focus was on the chimpanzee, but ethograms on other primates appeared as well. Our understanding of the range of expressions in other primates is at present far more advanced than that in Darwin's time. A strong social component has been added: instead of focusing on the expressions per se, they are now often classified according to the social situations in which they typically occur. Initially, quantitative analyses were sequential (i.e., concerned with temporal associations between behavior patterns), and they avoided the language of emotions. I will discuss some of this early work, including my own on the communicative repertoire of the bonobo, a close relative of the chimpanzee (and ourselves). I will provide concrete examples to make the point that there is a much richer matrix of contexts possible than the common behavioral categories of aggression, sex, fear, play, and so on. Primate signaling is a form of negotiation, and previous classifications have ignored the specifics of what animals try to achieve with their exchanges. There is also increasing evidence for signal conventionalization in primates, especially the apes, in both captivity and the field. This process results in group-specific or "cultural" communication patterns.**

KEYWORDS: **primates; facial expressions; communication; culture; emotion**

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Ann. N.Y. Acad. Sci. 1000: 7–31 (2003).
doi: 10.1196/annals.1280.003

EARLY HISTORY

Charles Darwin was the first to look at human facial expressions the way, at the time, only a biologist would—namely, as a structural albeit dynamic feature of our species that can be described and catalogued in the same way as the morphology of a plant or animal. *The Expression of Emotions in Man and Animals,* which first appeared in 1872,[1] is a masterpiece of detailed analysis and insightful conjecture. One of Darwin's main objectives was to show how human facial expressions (a) constitute a shared heritage of our species; (b) have parallels with the expressions of other animals, such as dogs, cats, and primates; and hence (c) provide one more argument—a behavioral one—for evolutionary continuity. Humans may express happiness differently than dogs; but all humans do it one way, and all dogs another way, indicating that the expression of emotions is a species-typical trait.

I will not explore this argument here in relation to the human face (see Ekman[2] for a review of the debate surrounding the universality of human facial expressions), but I do wish to stress how Darwin was an ethologist before the name even existed, giving us in human facial expressions a powerful example of what German ethologists later came to call an *Erbkoordination.* In its English translation, this concept lost the *Erb* part (i.e., "inherited") and gained in rigidity as it became known as fixed action pattern, or FAP. The central idea of the FAP is that in the same way that each species is characterized by structural features (e.g., wings, ears, digestive system), each is also endowed with stereotypical motor patterns. The insight of ethologists was that the FAP, since it occurs in recognizable form in all members of a species, must have been subject to the same laws of natural selection as any other trait.[3,4] This means that we are permitted to apply the concept of *homology* to the FAP's of different species, hence that we can trace their evolutionary origin (see below). It also implies that we can look at FAP's as adaptations—that is, assume that they have been selected for a purpose. In the case of facial expressions the obvious assumed function is visual communication: the face is the most conspicuous part of the body during face-to-face interaction.

This went further than what Darwin had proposed,[1] but Darwin's strength was that he had picked the one feature of human behavior that seems to fit most or all of the above conceptualizations. In fact, facial expressions fit the mold of inborn behavior far better than many of the behaviors now discussed as such in evolutionary psychology, such as maternal care or rape—not that these patterns cannot have a genetic component; but they are highly flexible, and their occurrence varies with learning and environment. As such, they are far removed from the complex facial muscle coordination and vocalizations, such as laughing and crying, that appear early in life and are remarkably uniform across individual humans and cultures. But not only did Darwin pick a prime candidate of innate behavior, he also recognized and carefully documented the similarity of our own facial movements with those of other pri-

mates. He suggested that of all human facial displays only blushing may be unique.

After Darwin we had to wait a long time until another scientist took up the baton of primate facial expressions. The one who did, Nadezhda Ladygina-Kohts, is little known in the US due to her having written in German, French, and most of all her native Russian. Kohts's comparison between a juvenile chimpanzee and her own son, first published in 1935, has only recently been translated into English.[5] This richly illustrated book reveals a wealth of insight into the emotional significance of primate facial expressions along with modern-sounding cognitive reflections on imitation, self-awareness, tool use, and other topics that have become fashionable only over the last few decades. It was Robert Yerkes who first drew attention to Kohts's pioneering research by reproducing excerpts and illustrations from her work in *The Great Apes*.[6]

Comparative descriptions along the lines of Darwin, but conducted in far greater detail and with a wider range of species, first reappeared in the literature with the studies of Jan van Hooff.[7,8] To illustrate the depth to which van Hooff went in cataloguing displays in an objective fashion, here is a description of the pigtail monkey's "protruded-lips face." Note the purely descriptive terminology: as an ethologist, van Hooff was careful to describe first, before assessing the possible motivation and function of a particular display:

> When a female pigtail monkey is in heat, a male which has access to this female may frequently show a most peculiar response. During the period the male may repeatedly smell at the genital region of the female, which bears large swellings. It then shows a facial posture which is mainly characterized by a protrusion of the lips. The upper lip moreover is slightly curled upwards and the lower lip is pressed against it tightly. The smelling may last a few seconds; after the male lifts its head and with the face directed slightly upwards and the eyes gazing up in an undirected way, it maintains the facial posture for a short time. In a number of cases copulation follows [pp. 56,57].[8]

Van Hooff (1967) brought to bear the concepts of ethology on facial expressions by speculating about their causal underpinnings as deduced from concomitant behavior.[8] He also tried to trace their phylogeny from its distribution over the taxonomic tree. Thus, he speculated about the origin of facial displays (e.g., lip-smacking may derive from the consumption of particles picked up during grooming) and the conflicting tendencies underlying compound displays, such as teeth-chattering, which may reflect a mixture of lip-smacking (associated with forward tendencies) and teeth-baring (associated with withdrawal in many species). Van Hooff also posited that displays that grade into each other may nevertheless have separate evolutionary origins, such as the human laugh and smile. Van Hooff's work still stands as the most comprehensive and insightful comparative analysis of nonhuman and human primate facial displays since Darwin.

Van Hooff's study was followed by Goodall's fine ethogram of wild chimpanzee behavior[9] and several reviews of primate facial expressions.[10–12] Un-

fortunately, some of these publications employed a rather vague or interpretative terminology. Thus, one publication labeled a certain facial expression "the threat display," which ignored that primates show a great variety of threat faces and that even the macaques studied possess more than one such display (Section 3a).[12] This author also upheld the unfortunate common name of "grimace," or "fear grimace," for what had been termed the "silent bared-teeth display."[8] According to my dictionary, a grimace is a sharp contortion of the face, hence a term that does not even begin to define the facial configuration involved. Imprecise terminology obscures the morphology that is the staple of any phylogenetic approach.

The modern study of the human face, which was initiated at around the same time as the above work, adopted from van Hooff and other ethologists the sensible habit of a strictly neutral terminology. In terms of descriptive detail, the nonhuman primate studies, which had been ahead until the 1970s, were soon left behind, however. The facial action coding system (FACS)[13] provided a more systematic muscle-by-muscle evaluation of the face. In defense of primatologists, however, it must be added that FACS requires high-quality photography of facial movements, which in naturally behaving primates is quite a bit harder to obtain than in people, who can be asked to sit still and look into a camera.

EVOLUTION OF SIGNALS

Homology and Ritualization

Darwin wrote perceptively about the facial expressions of nonhuman primates.[1] For example, he noted that the bared-teeth expression, shown in FIGURE 1 by a black Sulawesi macaque, occurs when the animal is pleased to be caressed. Retraction of the lips to expose both rows of teeth is indeed a relaxed, friendly expression in this species as opposed to the same expression in most other macaques, in which it signifies submission. How do we know this? Quantitative analysis of natural social interaction sequences among Sulawesi macaques demonstrates that the bared-teeth display predicts the onset of affinitive contact between sender and addressee, hence that it likely is associated with a positive social attitude.[14] In these macaques, teeth-baring often occurs mutually between individuals. In the better known rhesus macaque, in contrast, teeth-baring is given exclusively by subordinate to dominant individuals—hence never mutually—and is a common response to threats and intimidations (FIG. 2).[15] The colloquial term "fear grimace" for all teeth-baring expressions derives from the familiarity of researchers with the rhesus monkey—the most common laboratory primate in the West—rather than from a comprehensive look at the primate order, in which this expression has a variety of meanings.