

WHAT THE FACE REVEALS

Basic and Applied Studies of Spontaneous Expression Using the Facial Action Coding System (FACS)

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Facial Expression in Affective Disorders

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Recent progress in the study of facial expressions of emotion in normal individuals could have relevance to clinical investigations of depression. Universal facial expressions of emotion have been identified (Ekman, 1982a; Izard, 1971; Fridlund, Ekman, & Oster, 1987; Ekman & Friesen, 1986) for seven emotions—anger, contempt, disgust, fear, sadness, surprise, and happiness—that can be objectively and reliably distinguished one from another (Ekman, 1982b). Whether a disturbance in emotion is seen as a symptom (Beck, 1967; Abramson, Garber, Edwards, & Seligman, 1978) or as central in the etiology (Izard, 1977; Tomkins, 1963) of depression, the precise measurement of facial expressions of emotion could be useful in clinical investigations and perhaps also in the treatment of depression and other affective disorders. Specifying which of the seven emotions are evident in facial expressions, their relative strength, and any repetitive sequences of these emotional expressions might help to refine diagnosis, could be of aid in monitoring response to treatment, and might help to predict the likelihood of subsequent improvement or relapse.

The recent spate of studies using electromyographic (EMG) techniques to measure facial activity in depressed patients has shown such a potential (Carney, Hong, O'Connell, & Amado, 1981; Schwartz et al., 1976a, 1976b, 1978; Teasdale & Bancroft, 1977; Teasdale & Rezin, 1978) but there are two inescapable problems in using EMG to measure facial expressions. The first problem is inherent in the attachment of the EMG leads to the surface of the face. Measurement by this means is not only obtrusive but also may inhibit facial expressivity. Second, because many of the muscles active in diverse emotional states lay one on top of the other or are very close to each other, it is not possible to measure with EMG the occurrence of all seven emotions signaled by the face, any of which may be implicated in depression (Ekman, 1982b; Fridlund & Izard, 1983).

An alternative approach to measuring facial expressions of emotion is through systematically examining videotaped or filmed records to identify the muscular movements that constitute the emotional expressions. This approach is totally unobtrusive; the camera even may be hidden. The Facial Action Coding System (FACS) (Ekman & Friesen, 1976, 1978) is the only comprehensive, objective measurement technique

using this approach. Measuring facial movement in muscular terms, FACS identifies all seven emotions, the relative strength of each, repetitive sequences, and whether the expression is voluntary or involuntary. We also used an abbreviated, less costly version of FACS, the Emotion Facial Action Coding System (EMFACS) (Friesen & Ekman, 1986), which focuses just on muscular movements relevant to emotion.

In this first attempt to evaluate the potential of these measures of visible facial behavior in studies of affective disorders, we did not gather new interview materials. Instead, to reduce the expense of this exploratory study, we have analyzed archival interview records and a more recent but small sample of interviews. Although methodological limits in these samples constrain the conclusions that can be drawn, the analysis of these two samples illustrates some of the questions that can be asked by precisely measuring facial expressions: Do facial behaviors vary with diagnosis? Are such differences apparent only between depressives and schizophrenics, or do the emotional expressions distinguish major from minor depression? Are there sufficient differences among patients with the same diagnosis to suggest the possibility of using such measures to subclassify or refine diagnoses? Do the facial expressions predict the extent of subsequent clinical improvement, and would predictions based on such measures add information not ordinarily derived from standard clinical ratings of patient behavior?

Methods

Patients

Langley Porter Sample

In 1964, two of us (Ekman and Friesen) filmed all of the patients admitted with depressive symptoms during a six-month period to two wards of the Langley Porter Institute. A short standardized interview was conducted at the time of admission and again near the time of discharge. Seventeen patients had a final diagnosis of depression (8 neurotic, 9 psychotic), based on a consensus of the attending physician and ward head. We had three clinical psychologists independently evaluate these patients on the Brief Psychiatric Rating Scale (BPRS) (Overall & Gorham, 1962) after viewing the first part of the sound film admission interview, and then again after viewing the discharge interview. They also evaluated the extent of general improvement in psychiatric status on a 7-point scale on which 1 indicated regression, 4 no improvement, and 7 maximal improvement. We used the means of their ratings on the BPRS and on improvement in the data analyses.

George Washington Sample

As part of the NIMH Clinical Research Branch Collaborative Program on the Psychobiology of Depression (Katz et al., 1984), we were furnished interviews with 12 patients to study the feasibility of using our measures of facial expression in studies of affective disorders. The interviews were conducted when the patients were admitted to George Washington University Hospital and then again shortly before discharge. Their diagnoses were: 4 major depressive, 3 minor depressive, 2 bipolar disorder manic, and 2 schizophrenic. We selected two portions of the hour-long interviews for measure-

ment: the first eight questions, which largely dealt with how the patient currently felt; and the last five questions, which focused on diverse matters such as hobbies, whether the patient enjoyed life, and feelings about the future. The scores from both portions were combined in the data analyses. Because these patients did not change from admission to discharge—the mean difference in ratings of their pathology was less than half a point on a 7-point scale—we could not use this sample in our analysis of whether facial expressions at admission predict improvement.

Scoring Visible Facial Movement

The two techniques we used—FACS and EMFACS—are both anatomically based objective techniques for measuring facial movement observed on videotape or film. Using either technique, a coder “dissects” an observed expression, decomposing it into the specific facial muscles that produced the movement. The scores for a facial expression consist of the list of muscular actions that produced it. In FACS (but not in EMFACS), the precise duration of each action also is determined, and the intensity of each muscular action and any bilateral asymmetry is rated. EMFACS is more economical to use than FACS, not only because it disregards these aspects of facial movement but also because EMFACS scores only some, not all, observed facial activity. Using EMFACS, a coder decomposes an expression only when one of 33 predefined combinations of muscular actions is observed. These 33 predefined combinations include all of the facial configurations that have been established empirically (Ekman & Friesen, 1975, 1978) to signal the seven emotions that have universal expressions.

The scoring units in both FACS and EMFACS are descriptive, involving no inferences about emotions. For example, the scores for an expression would be that the inner corners of the eyebrows are pulled up and together by the combined action of medial frontalis and corrugator muscles, *not* that the eyebrows are in a sad position. While data analyses can be done on these purely descriptive muscular scores, FACS or EMFACS scores can also be converted by a computer-stored dictionary into emotion scores.

Coders spend approximately 100 hours learning FACS. Self-instructional materials teach the anatomy of facial activity, or how muscles singly and in combination change the appearance of the face. Prior to using FACS all learners are required to score a videotaped test (provided by Ekman and Friesen), to ensure they are measuring facial behavior in agreement with prior learners. To date more than 300 people have achieved high inter-coder agreement on this test in their measurement of facial behavior. Once a coder has learned FACS it takes only a few hours to become familiar with the procedures for using EMFACS.

Felt and Unfelt Happy Expressions

In addition to providing scores on the incidence of anger, disgust, fear, surprise, sadness, and contempt, FACS or EMFACS scores can be interpreted in a way that purportedly distinguishes whether an expression was made involuntarily and therefore is presumably a sign that the emotion displayed was felt, or was made voluntarily, and was not a sign of felt emotion. The idea that voluntary facial expressions could be distinguished from involuntary expressions is consistent with what is known about the

neural control of facial expression. Voluntary actions are controlled by corticobulbar pathways that emanate from the precentral motor cortex, while extrapyramidal influences are thought to control involuntary emotional facial movements. This "dual" control of facial expression is shown by the differential consequences of lesions in these two areas, which can impair voluntary but leave involuntary expressions intact, or impair involuntary expressions but leave voluntary expressions intact (Rinn, 1984).

Ekman and Friesen have proposed a number of ways to distinguish voluntary from involuntary expressions. We will consider only their hypotheses about how to make this distinction in regards to smiles, since the evidence to support this distinction for other emotional expressions is still quite sparse.

1. *Asymmetry.* When happiness is not felt but a smile is made voluntarily—to be polite, show agreement, encourage or mislead another—the action of the zygomatic major muscle that pulls the lip corners upwards will be stronger on one side of the face (Ekman, 1980). The smile will not be totally absent on the other side of the face, just weaker, often only slightly weaker. With right-handed persons, the unfelt smile is stronger on the left side of the face (Ekman, Hager, & Friesen, 1981; Hager & Ekman, 1985).

2. *Duration.* Inspection of thousands of spontaneous expressions revealed that nearly all of them last between .5ms and 4 seconds. On this basis unfelt expressions were hypothesized to be either less than .5ms or longer than 4 seconds (Ekman & Friesen, 1982).

3. *Muscles.* Duchenne (1862/1990) suggested that felt happy expressions include not only the activity of the zygomatic major muscle but the action of the orbicularis oculi muscle, which pulls the skin around the eyes inwards toward the eyeball. When happiness is not felt but a smile is assumed voluntarily, the zygomatic major would be active but not the orbicularis oculi.

A number of lines of evidence support this distinction between felt and unfelt smiles. Felt smiles occurred more often when subjects watched pleasant nature films, while unfelt smiles were more frequent when the subjects watched unpleasant surgical scenes (Ekman, Friesen, & Ancoli, 1980; Ekman, Davidson, & Friesen, 1990). Felt smiles occurred more often in response to a joke; unfelt smiles when the same subjects were asked to smile deliberately (Ekman et al., 1981; Hager & Ekman, 1985). There was evidence of differences in the pattern of hemispheric activation asymmetry during the expression of felt versus unfelt smiles (Ekman, Davidson & Friesen, 1990). Ten-month-old infants showed a greater number of felt smiles in response to the mother's approach as compared to a stranger's approach and a greater number of unfelt smiles in response to the stranger as compared to the mother (Fox & Davidson, 1987).

Scoring Procedures

The coders were not told the diagnosis of the patient, nor whether it was an admission or discharge interview. Table 15.1 lists how the scoring was done. Intercoder reliability was evaluated by computing the correlation (Spearman rank order) between the frequencies with which two coders scored the specific facial actions. The correlation between the coder using FACS was .87, and between the coders using EMFACS was .99; both correlations were significant beyond the .01 level of confidence.

TABLE 15.1. How the facial expressions were scored in the two samples

	<i>Samples</i>	
	George Washington <i>N</i> = 12	Langley Porter <i>N</i> = 17
Scoring procedure	EMFACS FACS	EMFACS
How felt-unfelt smiles were distinguished	Orbicularis Oculi & Duration	Orbicularis Oculi
Number of coders	2	2

Results

Can Facial Behavior at Admission Predict Clinical Improvement?

We begin with this question because it is the only one for which there was sufficient data to compute any statistics. Only the Langley Porter data were considered, as there was virtually no improvement in the George Washington sample. Although EMFACS measures facial behaviors relevant to a range of emotions, only behaviors relevant to sadness, contempt, felt happiness, and unfelt happiness occurred often enough in the interviews to be analyzed. Because of the small samples of neurotics and psychotics, and because this diagnostic distinction is not preserved in *DSM III*, diagnosis was disregarded in the analysis.

The first step was to calculate Pearson product-moment correlations between the EMFACS scores from the admission interview and the clinicians' ratings of improvement by the time of discharge. As a precaution against inflated correlations owing to the undue influence of a few extreme scores, Spearman rank-order correlations and Kendall nonparametric coefficients were also calculated. The confidence levels reported for the Pearson correlations reported below were also obtained with the two nonparametric correlations.

Table 15.2 shows that both contempt and unfelt happiness during the admission

TABLE 15.2. Predicting clinical improvement

Admission Measure	<i>Correlation with Improvement at time of Discharge</i>	
	Correlation	<i>p</i>
Contempt expression	Pearson $r = -.538$.05
Unfelt happiness expression	Pearson $r = -.600$.01
BPRS pathology rating	Pearson $r = .458$.06
Contempt + Unfelt happy	Multiple $R = .794$.001
Contempt + Unfelt happy + BPRS pathology	Multiple $R = .818$.001

Note: Correlations are between measures at the time of admission to the hospital and clinical improvement rated at the time of discharge.

interview were negatively correlated with the extent of clinical improvement by the time of the discharge interview. For comparison, the table also shows that the correlation between the BPRS total pathology score at time of admission with later improvement nearly reached significance. The patients who showed more contempt or unfelt happiness, or who were rated on the BPRS as being more pathological, improved less than other patients.

Regression analyses were employed to determine whether the contempt and unfelt happy scores were accounting for the same or independent variance in predicting clinical improvement, and whether the admission BPRS predicted a significant amount of variance in clinical improvement beyond that accounted for by the facial scores. Table 15.2 shows that entering both unfelt happy and contempt scores in the regression equation produced a large increase in the correlation with improvement. Addition of the admission BPRS, however, raised the coefficient from .794 to only .818, an R^2 change of only 3.9% ($F(1,13) = 1.538$, ns). Thus admission BPRS could not predict variance in general improvement ratings beyond that accounted for by facial scores at admission.

Entering the BPRS in the equation first and then adding the contempt and unfelt happiness scores provided an estimate of how much of the variance independent of the BPRS is added by the facial scores. Inclusion of the facial scores accounted for 46% more of the variance in improvement ratings than the BPRS alone, and this change was statistically significant ($F(2, 13) = 36.164$, $p < .001$). Thus facial scores of unfelt happiness and contempt predicted a significant amount of variance in clinical improvement ratings beyond that accounted for by admission BPRS. We inspected the distribution of emotion scores among the neurotic and psychotic subgroups to see if the scores that predicted improvement—unfelt happiness and contempt—might have been evident in just one of the two groups. That was not the case. Among neurotics and psychotics, some patients showed these two expressions.

Because age differences and length of interview could have confounded the results, correlations were calculated to examine the relationship between these variables and the facial scores. There were no significant correlations for either of these two variables, indicating that the results we report cannot be due to age or length of interview differences.

Problems with both the measure of clinical improvement and the BPRS should be noted. Both measures were based on clinicians' judgments after viewing the first portions of the sound film interviews. Thus, the clinicians making these evaluations were exposed to some of same facial expressions (in addition to the speech, voice, and body movement) that were measured with EMFACS. Such an overlap might have inflated the correlation between EMFACS and the measure of clinical improvement. Two arguments mitigate, at least in part, this criticism. First, we recomputed the correlations utilizing only the facial behavior in the last half of the interviews that had not been seen by the clinicians who had rated improvement, so there would be independence between the behavior measured with EMFACS and the behavior viewed for the global judgment of improvement. The correlations remained at the same level of significance. Second, the lack of independence was even greater between the BPRS and the improvement measures than between either of these and EMFACS, since these two judgments not only were based on viewing the same behavior sample but were made by the very same clinicians at the very same time. Yet EMFACS was more correlated with improvement than was the BPRS. In any case, future studies should employ a more independent measure of clinical improvement, based on judgments made in settings different from the one in which the facial behavior is measured. The same stricture would apply to the

sample of behavior on which the BPRS is based. It would be sensible to include also other standard clinical ratings, not just the BPRS.

Does Facial Behavior Differ Between Diagnostic Groups?

To examine this question we utilized the George Washington rather than the Langley Porter interviews. Even though there were very few patients in this sample, the diagnoses were current and there were four diagnostic groups to compare. The correlations among the frequency of an emotional expression, its duration, and mean duration were above .90. We report in figure 15.1 the mean duration for six emotions plus unfeigned happiness. (Contempt is not included as a separate category because we did not distinguish it from disgust, as we do now, when this scoring was done.)

Figure 15.1 shows that the major depressives showed more sadness and disgust and less unfeigned happiness than minor depressives. The manics showed more unfeigned happiness, unfeigned happiness, and less anger, disgust, or sadness than either depression group. The schizophrenics differed from the manics and the depressives in showing more fear and less of all the other emotions.

Does Facial Behavior Differ Within Diagnostic Groups?

Figure 15.2 shows the mean duration scores for the four major depressive patients. Patient 38 stands out from the others in showing no sadness, while Patient 10 differs from the others in showing much more unfeigned happiness and disgust. Figure 15.3 shows the mean duration scores for the three minor depressives. Again there appear to be individual differences in emotional expressions among patients with the same diagnosis. While similar in sadness, the patients differ in regard to fear and in regard to the happy expressions.

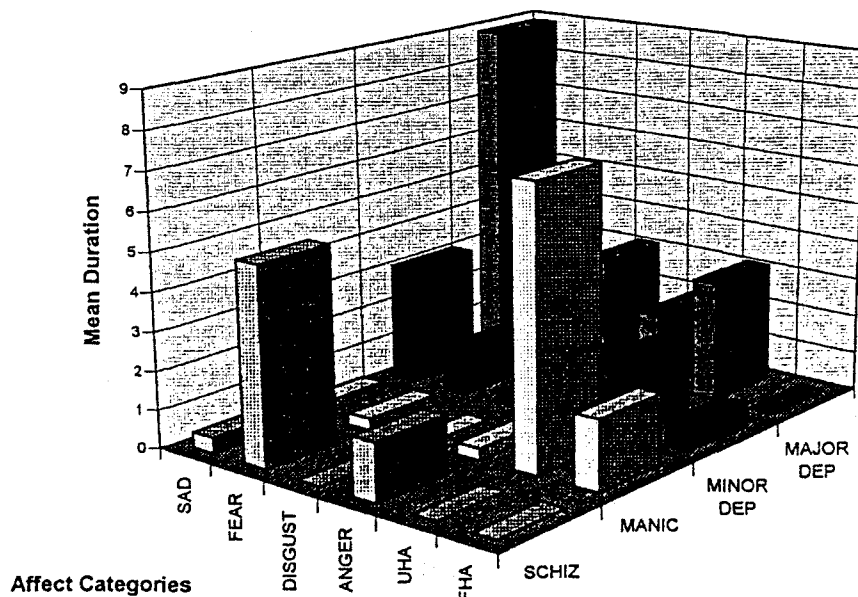


Figure 15.1 Mean duration of affect for psychiatric groups.

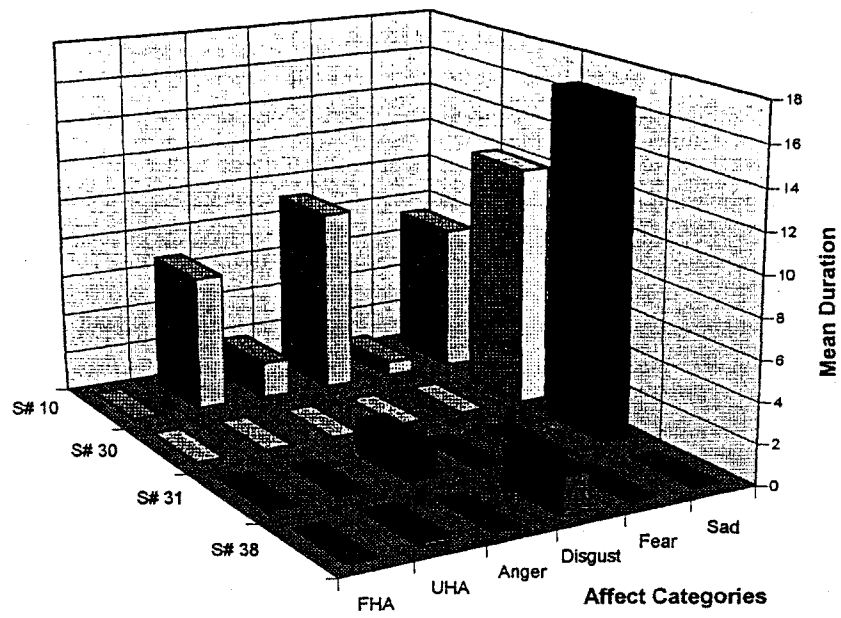


Figure 15.2 Mean duration of affect for major depressives.

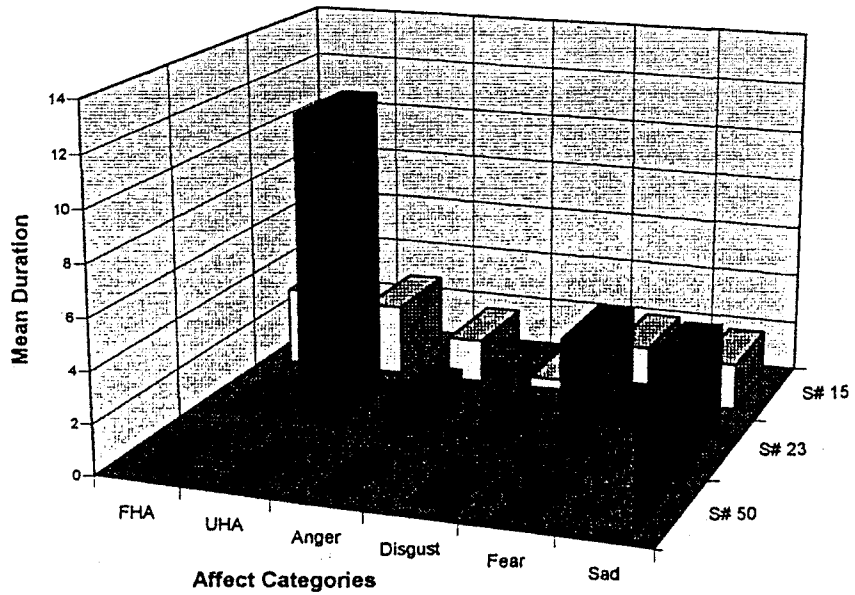


Figure 15.3 Mean duration of affect for minor depressives.

The Relationship Between FACS and EMFACS Scoring

Most clinical investigators would choose to use EMFACS rather than FACS simply because it is less costly, if the two measures produce similar results. FACS scoring, on the level of detail employed here, takes approximately one hour of scoring for each minute scored (a ratio of 60:1, scoring-to-interview time). In the George Washington sample, 20 minutes of facial behavior was scored from each of 12 patients, requiring 240 hours for FACS scoring. In EMFACS scoring, the ratio of scoring to interview time is 6 to 1. Scoring the George Washington sample with EMFACS required 24 hours.

We examined the correlation between FACS and EMFACS scoring to evaluate the similarity in the results obtained with these two measures. Different persons scored the George Washington interview sample with either FACS and with EMFACS. Rank-order correlations were computed for each scoring category in which at least ten instances of that type of behavior was scored. The mean Rho across the ten scoring categories that met this requirement was .656. For nine of the scoring categories, the correlation coefficient was significant beyond the 1% level of confidence. The one scoring category in which the correlation between EMFACS and FACS scores was not significant—the action of risorius muscle—had been the most infrequent, just meeting our requirement of at least ten occurrences, and had not yielded any differences between diagnostic groups.

Examining the number of times a type of facial behavior was scored by FACS and by EMFACS revealed that EMFACS is less sensitive than FACS. EMFACS achieves speed in scoring by not allowing the coder to inspect an expression more than three times, and by prohibiting slowed motion inspection. But this speed is gained at the cost of missing some instances of the behavior to be scored. Whenever it is important to know the absolute number of times a patient showed anger, or fear or sadness, and so forth, or exactly where in an interview each expression was shown, FACS will remain the preferred method. In many clinical studies in which it is important only to make relative differentiations, as in the data reported earlier in table 15.2, EMFACS will be the method of choice because it is less costly. (Ekman & Fridlund, 1987, have more thoroughly contrasted the advantages of each method in studies of affective disorder, and presented other arguments as to why FACS should be used in exploratory studies of affective disorders.)

Discussion

Despite the limits in the samples studied, the results should encourage clinical investigators to consider measuring facial expressions. At the very least, the results argue for repeating these studies with larger samples and better measures of clinical improvement and psychopathology. If the results were to replicate, measures of facial expression could have a variety of uses.

Facial expressions of emotion could be of use in refining diagnosis and in increasing the reliability of diagnostic classification. It would be important, for example, in new studies to determine whether the facial fear scores could help identify those patients in whom anxiety is evident in an otherwise depressed picture. Figures 15.2 and 15.3 suggest that facial measures may be of use also in distinguishing subgroups among patients who share the same diagnosis. Study could then be made of whether

those subgroups differ in etiology, length of illness, or response to one or another treatment.

The most exciting finding—that facial expression measures predicted later improvement (table 15.2)—must be regarded with caution. The sample size was small (17 patients) and there were, as discussed earlier, problems with both the improvement measure and the comparison with only one standard psychiatric rating scale. Caution, however, does not require ignoring the encouraging nature of what was found. Facial measures during the acute phase of the disorder did predict the extent of subsequent improvement, and the facial measures were more powerful than the Brief Psychiatric Rating Scale in predicting improvement, accounting for variance not accounted for by the BPRS. In addition to replicating these findings, further research might investigate whether facial measures of emotional state can predict response to different forms of treatment, is of use in monitoring treatment progress not just treatment outcome, the onset of unwanted side effects with the neuroleptics, and in predicting relapse.

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AFTERWORD

Depression and Expression

PAUL EKMAN

The first version of this article was written in 1982 and was rejected for publication. We revised it and resubmitted it two more times, and it was again rejected. The reviewers complained that the diagnostic categories in sample 1 are no longer relevant, and the size of sample 2 was too small. We were sufficiently discouraged that none of us again did any research on psychopathology and returned instead to basic research on emotion and expression.

I included this article because I am more convinced than ever that it did obtain important findings. The fact that facial measures did better than clinical ratings by expert clinicians (on the BPRS) in predicting improvement is of import and deserves to be replicated. The findings that unmet happiness (not felt happiness) correlated with improvement adds to the evidence that this distinction is an important one, a fact borne out by many of the articles in this book. The finding on contempt is also a negative predictor of improvement and is also consistent with more recent findings on expression and psychopathology reported in this book. And the discovery of individual differences in expression among patients with the same diagnosis (in sample 2) also suggests the possible value of distinguishing subgroups of patients on the basis of emotional expressions when evaluating treatment effects. (This finding on individual differences in patients with the same diagnosis and the finding reported in the next paragraph were obtained in the middle 1970s.)

This article also reports the only evidence on the relationship between FACS and EMFACS scoring. This is an important methodological issue for anyone who is considering facial measurement, since as the article reports, EMFACS requires only one-tenth the scoring time of FACS. But as the article reports, this benefit is offset by some costs. Some emotional expressions detected by FACS are missed by EMFACS. I will reserve for the last chapter of this book a more general discussion of when to use FACS, EMFACS, or even simpler scoring or rating techniques.