DEPRESSION and EXPRESSIVE BEHAVIOR

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3 ASSESSMENT OF FACIAL BEHAVIOR IN AFFECTIVE DISORDERS

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INTRODUCTION

This chapter suggests guidelines for measuring facial behavior in major affective disorders. We first discuss the relevance of facial expressions for studying major affective disorders. The two major decisions involved in examining facial behavior are described—selecting the conditions under which to obtain behavioral samples, and the methods for measuring the behavior. We then suggest priorities for research relating facial expressions to affective disorders, and we emphasize questions that must be addressed before clinical measurement of facial behavior is practical.

Clinical research on facial behavior in patients with different types of affective disorders is needed. This chapter provides clinical investigators with concepts and methods requisite for making informed decisions about measuring facial behavior. The chapter closes with a speculation of how the clinician of the future will use facial behavior in psychodiagnosis.

FACIAL EXPRESSIONS

It seems logical to measure the face in studies of affective disorders because the face is one of the main emotion signal systems. It is surprising that there have been so few studies on the topic (for reviews, see Ekman & Friesen, 1974; Fridlund, Ekman, & Oster, 1986; Jones, submitted for publication). The lack of adequate tools for measuring facial behavior is probably paramount in explaining the dearth of research. Research has also been limited by a failure to consider just how affective disorders might alter facial behavior.

Two issues need to be addressed to clarify the matter: First, we emphasize that facial behavior signals more than just emotion. Second, we distinguish among emotions, moods, emotional traits, and emotional disorders, considering how each of these phenomena may be manifested in facial behavior.

Types of Facial Actions

Some facial actions can signal emotion; most do not. Three types of facial actions are particularly relevant to affective disorders but do not signal emotion:

1. Instrumental facial actions such as lip-wiping and wetting often occur as anticholinergic side effects of antidepressant medication. Such actions should be monitored, but they should be separated from emotion signals.
2. "Emblematic" facial actions (Ekman, 1973) are socially learned, symbolic facial gestures whose meanings are widely shared within a culture. Examples include the wink, the facial shrug, and the tongue defiance display. These are premeditated, voluntary language-like facial expressions. We suggest that the frequency of emblematic actions drops with the onset of depression or increases in mania, and normalizes with clinical improvement. However, their occurrence in native-born Americans is infrequent and unlikely to contaminate facial behavior samples significantly. Studying emblematic actions in affective disorders may be more profitable in cultures where these behaviors are more frequent (e.g., Southern Italy).
3. Conversational facial signals (Ekman, 1979) include both the facial actions that punctuate spoken language and those made while listening. Conversational signals encourage a speaker to continue, call for more information, or presage an interruption. Ekman and Friesen (report to NIMH, 1982) found in a study of depressed and schizophrenic patients that conversational signals outnumbered emotion signals by a ratio of 3 to 1. The predominance of conversational signals prompted Fridlund and Gilbert (1985) to propose that the face be considered a "paralinguistic" display system.

Conversational signals, as important indices of social engagement, might be especially useful in diagnosing affective disorders, measuring their severity, and charting their course. We believe that depression is characterized by social disengagement and mania by hyperengagement. However, no research exists on conversational signals and affective disorders. Some of the facial measurement techniques described below can separate conversational from emotion signals. Other systems ignore the distinction and combine the two types of signals.

We focus primarily on techniques for measuring emotion using facial behavior because: (a) techniques for facial measurement were developed for studying emotion; (b) there is ample evidence that these techniques can accurately measure emotion; and (c) preliminary data suggest that these techniques are useful in studying affective disorders.

Distinguishing Facial Signs of Affective Phenomena

Facial behavior can be visible or invisible, because weak levels of facial muscular activity that produce no apparent movement are measurable with electromyography (EMG). In unpacking facial behavior we further distinguish (and suggest) the terms *expression configuration* (the specific muscles deployed in an expression) from *expression dynamics* (the amplitude-time course of the configuration; see Fridlund, Schwartz, & Fowler, 1984). Both properties are related to emotion: expression configuration specifies the type of emotion, and expression dynamics specify its strength.

There is consistent, robust evidence (see Fridlund, Ekman, & Oster, 1986, for the most recent review) for the facial configurations that signify fear, anger, disgust, contempt, combined sadness/distress, surprise, and happiness. Evidence is weaker for distinguishing guilt or shame from sadness/distress, and for measuring interest or different varieties of happiness (such as amusement, physical pleasure, and contentment).

There is less evidence about the dynamics of facial expressions. Two studies have shown that intensity and duration of muscular actions vary with strength of self-reported emotion (Ekman, Friesen, & Ancoli, 1980; Fridlund et al., 1984). Both configurative and dynamic features distinguish voluntarily-produced facial signals of emotion from more genuine, involuntary expressions (Ekman, Hager & Friesen, 1981; Ekman & Friesen, 1982; Ekman, 1984; Hager & Ekman, 1985). Voluntary-involuntary differences could be relevant for measuring emotions that a patient denies or is reluctant to disclose. These differences are strongest for happiness (Ekman & Friesen, 1982) but they may extend to other emotions as well.

In a study of archival records of depressed patients diagnosed according to DSM-II, Ekman, Matsumoto, and Friesen (1986) found that the distinction between voluntary and involuntary smiles was strongly related to diagnosis and improvement. Involuntary "felt" smiles were defined as expressions that involved both *zygomatic major* (the muscle that retracts the lip corners to form a smile) and *orbicularis oculi* (the eyelid muscle that lends the "crinkly-eye" appearance), whereas voluntary "unfelt" smiles involved only the *zygomatic major* without co-contractions of *orbicularis oculi*. Neurotic depressives showed more unfelt smiles than psychotic depressives on hospital admission, but the two groups were equivalent at discharge. Neurotic depressives showed more felt smiles than psychotic depressives at discharge, although the groups were equivalent on admission.

Other than those facial actions already prototypical of emotion, there is no evidence for any facial behaviors characteristic of moods, emotional traits or affective disorders. Ekman (1984) argued that these phenomena are likely to be characterized by unique facial dynamics but not configurations. Ekman distinguishes between an emotion (e.g., sadness/distress), a mood (feeling blue), an emotional trait (e.g., dysthymia) and an emotional disorder (depression).

"Blue" moods and clinical depressions are probably signalled by the occasions that produce certain facial configurations and the dynamics of these configurations (Ekman, 1984). In a blue mood, one readily feels sadness, and that emotion can be called forth easily. Periods of sadness will generally be longer and more intense than usual, and the sadness is more difficult to regulate, attenuate, or inhibit. These characteristics are even more pronounced in major affective disorders, in which affect can be "flooded" (Ekman & Friesen, 1975). Flooded affect emotions occur in response to events that are rarely evocative. They recur without apparent provocation, and their intensity and duration interfere with eating, working and sleeping.

DSM-III MAJOR AFFECTIVE DISORDERS AND EMOTION

In describing major affective disorders, DSM-III (American Psychiatric Association, 1980) specifies emotions, broad emotional features, and moods. Table 3.1 lists these affect-related terms; the relevant emotions are supplied paren-

TABLE 3.1
Affective Phenomena and DSM-III Criteria for Major Affective Disorders

	Major Depression	*Manic Episode*
Specific Emotions	Absence of pleasure (no happiness) Guilt	
Moods	Dysphoric (sadness/distress) Irritable (angry) Anxiety (fear)	Elevated (happiness) Irritable (angry) Dysphoric when not elevated or irritable
General Emotional Level	Agitated Retarded Anergic	

thetically. We note particularly that no specific affects are required for DSM-III diagnosis of major affective disorder. This nonspecificity in affect may reflect essential variability of emotion in major affective disorders, and with other evidence it forced Fridlund and Volpicelli (in preparation) to consider whether affective features are in fact a core property of depression and mania. The nonspecificity may also reflect subtypes of affective disorders, or previous unreliability in assessing emotions related to major affective disorders.

Specific emotions listed in Table 3.1 can be measured by most of the techniques described below. It is premature to focus exclusively on just those emotions. Research on facial behavior in affective disorders should include measurement of facial signals for all emotions, including disgust, contempt, and surprise. Table 3.1 also suggests the need to measure the range and dynamics of various facial configurations to achieve a measure of general emotionality. As mentioned previously, conversational signals are also useful as a measure of social disengagement or hyperengagement.

ALTERNATIVES FOR ELICITING FACIAL BEHAVIOR

Several clinical interaction formats allow sampling of facial behavior. Each has its own advantages and disadvantages. We consider four types, two of which are commonly part of clinical research: (1) unstructured clinical interviews; and (2) structured clinical interviews. The nonstandard procedures are: (3) structured imagery and reminiscence tasks, and (4) unobtrusive measurement of on-ward or on-site behavior. Unobtrusive measurement of facial behavior *in situ* is tactically impractical in most settings.

The first three methods require interaction of the patient with the clinician, and interaction with the professional may have a reactive impact upon the patient's facial behavior. Patients may show facial signs of "evaluation apprehension" (e.g., knitting of brows) or undue politeness (e.g., appeasement smiles), and depending on the patient, exaggeration or minimization of distress. It is unknown how a patient's tendency to exaggerate or minimize complaints affects facial behavior and psychodiagnosis. Nor is it known whether individuals with affective disorders show atypical responses in this interaction. In either case, patients' facial behavior while interacting with clinicians cannot be assumed to reflect a core property of affective disorder without unobtrusively verifying the behavior in nonclinical settings.

Any of the three interaction formats requires the investigator to choose whether to use a hidden or a visible camera. The hidden camera allows less reactive measurement of facial behavior, but it may pose problems in obtaining informed consent. The visible camera obviates difficulties in obtaining consent but may result in attenuated or distorted facial behavior (e.g., Kleck, Vaughan, Cartwright-Smith, Vaughan, Colby, & Lanzetta, 1976; however, note that such studies have not used patient populations), and its presence may harm some patients' treatment. Videotape or film recording may be employed; Walbott (1982) presents the advantages and constraints of each format.

Brief reviews of the three interaction formats for obtaining clinical samples of facial behavior follow.

Unstructured Clinical Interview

This most common psychodiagnostic method carries the advantages of varying length, the flexibility to explore in depth specific features of the patient's presentation, and the ability to elicit affect from a patient who would be unexpressive under more restrictive conditions. The unstructured interview has the severe drawbacks that facial behavior is likely to be very sparse, and, given the uniqueness of each interview, comparisons across individuals are nearly impossible.

Structured Clinical Interview

The structured interview (e.g., the SADS protocol) has the advantages that the interview format is relatively consistent, and patients' facial behaviors from question to question are more readily comparable. One liability of the structured interview is the inflexible transition that must occur between questions. From our viewing videotapes of SADS interviews with patients, we believe that these transitions can be jarring and often inhibit emotional expression. Like the unstructured interview, the structured interview readily yields conversational samples but still requires long recording epochs to obtain facial emotional behavior. Additionally, the optimal methods for parsing interview segments into behavioral samples are not known.

Imagery, Self-reference, and Reminiscence Tasks

Laboratory experiments on induced mood often use a variety of imagery, self-reference, or reminiscence tasks. In imagery tasks, patients may be asked to recall, then "re-experience", personally significant emotional events. Alternatively, they are asked to imagine "affective imagery" items culled from standardized protocols of everyday emotional situations. Self-reference tasks such as Velten statements rely on suggestion to elicit emotion ("I feel blue"). Imagery and self-reference tasks typically employ items or statements with known (or predictable) emotion content. Reminiscence tasks do not involve prior procurement of an "item" or "situation" for eliciting emotion; they rely on free recall by patients of material that may have varying, unpredictable emotion content.

Although imagery, self-reference, and reminiscence tasks seem to provide an easy way to elicit authentic emotion, closer analysis suggests otherwise. These tasks have in common the request by the experimenter or clinician to experience emotion. Thus any expressions of emotion induced in these procedures may be as reflective of compliance as of felt emotion, and inhibited or histrionically intensified facial behavior may occur. However, these tasks have an advantage over the structured clinical interview in that emotion elicitors may be more potent and the emotion content specified more precisely.

These structured tasks are all economical. They can be used to evoke emotion quickly and in a relatively controlled fashion, despite their confounding with effects of compliance. The twin advantages of economy and standardization are important when facial behavior is the major interest. Facial behavior is very densely packed. Whatever task is employed, acquiring and measuring the facial behavior will take considerable time. Therefore, brief sampling epochs are desirable, and the fact that standard tasks can fit into brief epochs is highly advantageous.

A disadvantage of imagery and self-referent tasks is that they exclude conversation, and facial conversational signs may change significantly in major affective disorders. Reminiscence tasks include conversation but typically do not use standardized emotion elicitors. A good compromise is to use imagery which is guided and constructed by the patient from personal experience. Facial behavior can be sampled during the imagery. The patient is then asked to recount his or her experience of the imagery, and conversational signals (possibly admixed with emotion signals) can be observed.

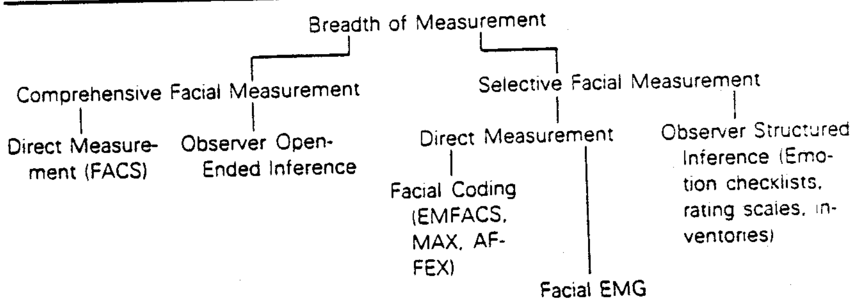
MEASUREMENT OF FACIAL ACTION

Many systems have been developed to structure and analyze observations of facial action. Ekman (1982) has provided a detailed comparison of fourteen major facial coding systems. Most evolved for studying emotion to the exclusion of nonemotional facial behavior. No facial measurement methods have been developed for studying psychopathology. As a result, theory and data are sparse concerning the relationship of emotional and nonemotional facial behaviors to major affective disorders.

Facial behavior, as previously mentioned, is densely packed. The face contains nearly 80 expressive muscles that act in rapidly changing patterns and which, by their co-contractions, can form tens of thousands of facial expressions. Consequently, choices about how much facial behavior to measure are crucial. Also crucial are choices about *which* facial behaviors to measure.

Table 3.2 diagrams the decisions facing the clinical investigator in choosing a facial measurement system. The first choice is whether facial behavior is to be measured comprehensively or selectively. In selective measurement, certain facial behaviors, or patterns of behaviors, are measured and the rest are excluded. Selective facial measurement is the method of choice whenever the behaviors to

TABLE 3.2
Decision Tree for Measuring Facial Behavior



be measured can be specified in advance. However, it is not known what kinds of facial behavior are most likely to aid in diagnosing or quantifying the course of an affective disorder. This point underscores our earlier emphasis on measuring more than just emotions specified or implied by DSM-III. Comprehensive measurement is costly but in the present state of knowledge about facial behavior and affective disorders it is mandated. Furthermore, it is the only way to discover unexpected facial behavior correlates of affective disorders. Comprehensive measurement can be performed either using observers or by direct measurement of facial activity.

Comprehensive Facial Measurement

There are two major comprehensive methods of facial measurement. One uses open-ended inferences drawn by observers of facial behavior. The other measures facial behavior directly. Observers may be able to infer phenomena that no direct measurement system is yet configured to detect. On the other hand, detailed information that can be directly measured in the face may be missed by observers.

Open-ended Observation

Open-ended observers' reports about facial behavior are rarely employed. Yet they are among the simplest measurement methods, and they offer an unusually wide net with which to assay facial behaviors relevant to affective disorders. Observers are simply shown videotaped facial behavior. They are then asked to report what they see. Their responses are audiotaped and collated. The responses can be unstructured, or observers can be prompted to provide their judgments about "disorders," "moods," "traits," and "emotions." Systematically collecting observers' open-ended impressions would provide valuable data on how individuals perceive patients' affect. It allows one to incorporate in theory and research all reasonable inferences about facial behavior and affective disorders.

What kinds of observers should be used? We suspect that naive observers, trained nonexpert observers, and expert clinicians would provide different and complementary reports that could guide future hypothesis construction and testing. Should observers view videotapes that provide the full sound track? Past research has involved omitted or filtered speech or provided just the video image. However, we see no reason in initial research to forsake the ecological validity of the full audiovisual presentation. Including the sound track also simplifies separating conversational from emotional facial behaviors, and presently elicited from referential emotion (i.e., produced by memory or reflection).

Comprehensive Direct Measurement of Facial Behavior

In contrast to open-ended observation, in which observers supply impressions of facial behavior, here the behavior itself is measured. Comprehensive general-purpose direct facial coding is provided uniquely by Ekman and Friesen's Facial Action Coding System (FACS; Ekman & Friesen, 1976, 1978). Based on empirical findings, FACS includes 44 visibly-discriminable component facial behaviors which, singly or in combination, account for all visible facial movement. Within FACS, the component behaviors are called Action Units, or AUs. AUs are scoreable according to 5-point intensity ratings. Because the timing of muscular actions seems critical for discriminating types of facial behavior, FACS provides coding of AU dynamics, that is, timing of AU onset, apex and offset. High interrater reliabilities have been obtained using FACS.

FACS takes considerable time to learn and use, and it requires repeated, slow-motion viewing of facial actions. FACS is thus currently unsuitable for real-time coding. By its nature, FACS includes more distinctions than may be needed for assessing any one patient population. Initially its use increases the expense and tedium of measurement. However, once meaningful behavioral units are derived empirically, elementary measurement units can be collapsed and subtle distinctions disregarded. Flexibility in retaining and discarding AUs will be critical in early research on facial behavior and affective disorders, because initial hypotheses will be largely speculative.

Selective Facial Measurement

Several methods are available for measuring facial behavior selectively. Selective measures are economical because they exclude many types of facial behavior or its fine-grained features (e.g., expression dynamics). Selective measures are preferable when the facial behaviors of value are known in advance.

A major liability of these methods is that they were not developed for studying affective disorders. Their selectivity is usually based on theoretical preconceptions that may be irrelevant for diagnosing or charting the course of major affective disorders. They do not usually parse emotional from conversational facial behaviors, and some behaviors characteristic of emotion are omitted. Therefore, the bases for selecting and quantifying facial behaviors may not be optimal for studying affective disorders. Selective methods of facial measurement include both observer judgments and direct measurement. Selective direct measurement can be performed using either visual coding or facial electromyography.

Selective Observer Judgment

In the judgment approach, observers are asked to make judgments about slides, films, or occasionally, live presentations of facial expressions. For example, videotapes of depressed patients are shown to judges who are asked to classify each patient as having Major Depression with or without Melancholia. Judgment approaches typically involve placing expressions either along emotion scales (e.g., Schlosberg, 1941, 1952, 1954) or in discrete emotion categories (e.g., Izard, 1971, 1972, 1977; and see review of scaling and categorical approaches by Ekman, Friesen, & Ellsworth, 1982). They can equally well be used to assign individuals psychodiagnoses. Unlike open-ended observation, observer judgment methods by nature constrain observers' responses. The constraints on observer responses make judgment methods inappropriate for exploratory studies of facial behavior in affective disorders. Rather, construction of rating scales, categories, checklists, etc., should follow pilot research using comprehensive measurement.

Selective Direct Measurement

In the selective direct measurement approach, facial behaviors are specified in advance and sampled at a predetermined level of precision. Specification of behavioral units proceeds from theory, research or clinical inference. Selective direct measurement is performed using visible facial coding systems or by electromyography. Selective visible facial coding systems require a videotaped record of the patient's facial behavior. Electromyography does not require videotaping, but requires placement of recording electrodes for monitoring the patient's physiological activity.

MAX and AFFEX. The major exemplars of selective direct measurement facial coding systems are the Maximally Descriptive Facial Movement Coding System (MAX; Izard, 1979), the System for Identifying Affect Expression by Holistic Judgment (AFFEX; Izard & Dougherty, 1980), and the Emotion Facial Action Coding System (EMFACS; Friesen & Ekman, 1983). MAX and AFFEX are based on early recognition studies that established the universal association of certain facial expressions with specific emotions. Neither MAX nor AFFEX provides an exhaustive listing of possible facial behaviors. MAX, for example, provides only those 27 descriptors believed by Izard to be necessary to form judgments about seven "primary" emotions. No data are provided to show that the excluded facial actions do not reflect emotion. Thus whether the systems exhaustively measure facial behavior relevant to major affective disorder cannot be internally confirmed or disconfirmed. Expression dynamics are disregarded; facial behavior is instead seen as "on" or "off."

EMFACS. EMFACS represents Ekman and Friesen's desire to supplement the comprehensive FACS with a standardized selective alternative that measures broader, emotion-related facial actions. EMFACS considers only emotional expressions, and among those only the AUs and AU combinations best supported by empirical findings or theory as emotion signals. Like MAX and AFFEX, EMFACS is a selective direct measurement coding system, but with an important difference—its systematic derivation from FACS permits confident statements about its omissions. The solidity of EMFACS' empirical grounding is suggested by numerous concurrent validation studies with FACS. These indicate high correlations (>.8) of EMFACS and FACS codings.

Coding time with EMFACS is speeded, albeit at the expense of subtler AUs and AU combinations, including those indicative of conversational signals or selfmanipulations. Precise temporal dynamics of the facial actions are replaced by unitary demarcations of peak actions. To maintain an empirical approach in EMFACS scoring, facial actions are, like FACS, described in terms of numerical codes. Coders are also requested not to interpet actions as emotion signals until they are tabulated *post hoc* and classified according to EMFACS criteria.

Although not all FACS emotion hypotheses have been tested, a number of predictions have been supported (see review by Ekman, 1982). Studies of spontaneous emotional expression using self report as a validity criterion support predictions about actions that signal happiness, fear, distress, and disgust. Studies employing observers' attributions of emotion as a validity criterion support FACS predictions for these emotions as well as for surprise and anger.

Before considering the alternative technique for selective direct facial measurement—electromyography—we consider two pilot studies of facial behavior and affective disorders to illustrate the utility of FACS and EMFACS.

Ekman and Friesen (report to NIMH, 1981) used FACS to measure the facial behavior shown by patients on admission to an inpatient psychiatric facility. All facial movement during the first 8 questions and the last 5 questions in a standard interview was measured. The DSM-II diagnoses of the patients were: major depressive (N = 4), minor depressive (N = 3), manic (N = 3), and schizophrenic (N = 2). Results reflect combined scores from the two interview samples.

FACS measurements identified 5,987 separate expressions. Some were composed of one muscular action; others involved co-contractions of 2 to 5 muscles.

About one third (1770) of these expressions involved actions predicted by FACS to signal emotion. Most frequent were nonemotional facial actions such as lowering or raising the eyebrows to punctuate speech.

Figure 3.1 shows that patients diagnosed with major depression showed more sadness and disgust and fewer unfelt-happy expressions than minor depressives. Manics showed more felt-happy, unfelt-happy and fewer anger, disgust or sadness expressions than either depression group. Schizophrenics differed from manics and depressives in showing more fear expressions and fewer of the other emotional expressions. Figure 3.2 shows emotion scores for each of the four patients with major depression. Individual differences are apparent for sadness (fewer for patient 38) and unfelt happy (more for patient 10) expressions.

Patient groups also differed in their nonemotional speech-punctuating facial movements. Depressives and schizophrenics showed fewer speech-punctuating facial movements than manics. Major depressives showed much more brow lowering than brow raising in punctuating speech than the other groups, whereas manics showed the opposite pattern.

This study shows the feasibility and promise of facial measurement in diagnosing affective disorder, although small sample sizes prevented drawing firm conclusions. Nor was it possible to evaluate whether facial measurements at admission predicted clinical improvement.

Ekman, Matsumoto, & Friesen (1986) used EMFACS to score facial behavior of psychiatric inpatients filmed by Ekman and Friesen in 1964. Patients were

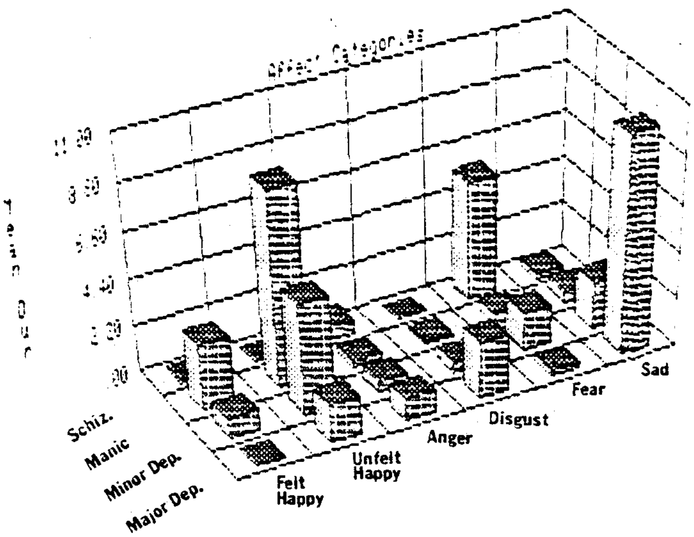


FIGURE 3.1. Mean duration of affect for psychiatric groups.

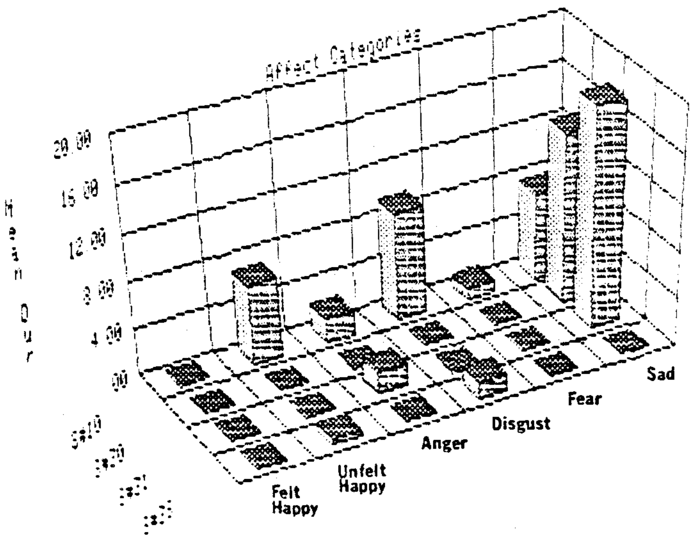


FIGURE 3.2. Mean duration of affect for major depressives.

filmed during standardized interviews at admission and at discharge. For 17 patients the attending physician and the ward chief agreed by the time of discharge on a DSM-II depression diagnosis. Mean age of these patients at time of admission to the hospital was 47.5 years. Patients' hospital stays averaged 68 days.

Brief Psychiatric Rating Scale (BPRS) ratings were made independently by three clinical psychologists after viewing the first 2 minutes of the admission interview. They then viewed the first 2 minutes of the discharge film. They made a second set of BPRS ratings, and also rated each patient on degree of clinical improvement. A single coder measured facial behavior with EMFACS. A second reliability coder independently measured the facial behavior shown by 8 of the patients in focal 1-minute interview samples. Intercoder reliability of EMFACS was .821.

Table 3.3 shows that more felt-happy expressions and fewer unfelt-happy expressions occurred at discharge relative to admission. The number of sad expressions tended to decrease, but the change was not significant. Patients who showed sadness expressions were rated by the clinicians as less disturbed (lower BPRS scores), both at admission and discharge (Table 3.4). At admission patients who showed sad expressions did so when describing current feelings. At discharge patients who showed sad expressions did so when describing how they *had* felt when admitted. Sadness at admission did not predict clinical improvement by discharge (Table 3.4).

TABLE 3.3
Number of Patients showing Happy Facial Expressions in Admission and Discharge Interviews

	Interviews	
	Admission	*Discharge*
Felt-happy expressions	3	12
Unfelt-happy expressions	14	5
$X^2 = 9.63$, df = 1, $p = .01$		

On admission, patients who showed at least one happy expression (felt- or unfelt-happy), were rated as less disturbed (mean BPRS = 30.5) than those who did not (mean BPRS 43.2, $p < .01$). This difference was independent of whether they also showed a negative emotional expression. There was almost no overlap (1 of 17 subjects) in BPRS score distributions of those who did and did not show a happy expression.

Contempt expressions and unfelt-happy expressions at admission were independently associated with *less* clinical improvement. Each expression correlated with improvement even when variance associated with the other emotion was statistically removed (Table 3.5). Severity of disturbance on the BPRS at admission was positively correlated with subsequent clinical improvement. Table 3.5 shows that when unfelt-happy and contempt expression scores at admission were added to the BPRS scores in a multiple correlation with clinical improvement, the correlation was significant. Expression scores explained 46% of the variance. When expression scores were entered first in the multiple correlation, they correlated .79 ($p < .001$) with subsequent clinical improvement. Adding the BPRS accounted for only 4% of predicted variance.

Findings from this study are very promising but are limited in two regards. First, patients were not diagnosed using DSM-III. Second, the expert BPRS

TABLE 3.4
BPRS Ratings of Patients who Did or Did Not Show Any Sadness Expressions

	BPRS Rating			
	Admission Interview		*Discharge Interview*	
	Mean	*SD*	*Mean*	*SD*
Sadness expressions	32.8	8.1	19.5	1.6
No sadness expressions	38.5	7.7	24.5	5.5
p (two-tailed)	.03		.01	

TABLE 3.5
Correlations Between Facial Emotion Scores on Admission and Ratings of Subsequent Clinical Improvement

	Rank Order Correlation	*Partial Correlation*
Contempt	$-.54$ $p < .05$	$-.69$ $p < .002$ (controlling for Unfelt-happy)
Unfelt-happy	$-.60$ $p < .01$	$-.71$ $p < .001$ (controlling for Contempt)

ratings of severity and clinical improvement were made after observing only two minutes of interview behavior. Despite these limitations, this pilot study shows the feasibility and clinical relevance of directly measuring facial behavior during standard interviews.

Facial Electromyography. Now we consider the alternative method for selective direct facial measurement, facial electromyography (EMG). Fridlund and Izard (1983) presented principles of facial EMG and reviewed the relevant literature. Fridlund and Cacioppo (in preparation) presented general guidelines for electromyographic research. In facial EMG, sensitive amplifiers detect tiny electrical discharges generated by contracting facial muscles. Contact with the muscle tissue can be made directly by using indwelling fine wires. More frequently, recording proceeds indirectly through skin, using surface electrodes filled with conductive paste and attached to the skin with adhesive collars.

Facial EMG has three advantages over direct observation of the face. First, the EMG signal is instantaneously detectable and thereby lends itself to immediate recording. Second, the EMG signal offers a more finely graded measure of muscle activity than can be provided by visible facial coding systems or observer judgments. Third, EMG techniques detect muscle contractions that are too small to be observable (see Ekman, 1982). This advantage may be important in assessing "covert" emotional signals or mood states.

There are several disadvantages to the use of facial EMG. Recording facial EMG requires an extensive electrode application procedure. For this reason,

TABLE 3.6
Severity and Emotion Measures at Admission and Clinical Improvement

Measure at Admission	
BPRS	$r = .46$, $p = .06$
BPRS + contempt + unfelt happy	$R = .82$, $p = .005$
Unfelt happy + contempt	$R = .79$, $p = .001$
Unfelt happy + contempt + BPRS	$R = .82$, $p = .001$

recording from more than three or four facial sites at one sitting is likely to be too time-consuming and stressful for the patient. Because the electrodes make direct contact with the face, the patient is usually manifestly aware that he/she is participating in research concerning the face. The patient's self-consciousness can result in distorted or attenuated facial behavior (Fridlund & Izard, 1983; Kleck et al., 1976). The leads, paste, and collars inhibit movement and may be torn by strong muscle actions. Attaching the recording discs can be problematic on males with heavy beard growth. If fine-wire recording is performed, implantation of the electrodes often produces irritation and pain.

Nor can a facial EMG signal be taken necessarily as an accurate representation of ongoing dynamic muscle activity. The relationship between detected electrical output at an EMG site, and the mechanical force exerted by a muscle, may change over time as a function of fatigue (Mulder & Hulstijn, 1984).

Given the practical limits on number of electrodes that can be applied, careful *a priori* judgments must be made about which facial sites to monitor. Facial EMG is therefore a selective direct measurement method.

Facial EMG has the additional drawback that conversational and emotional signals cannot be distinguished without an accompanying audio record. The typical surface electrodes used in facial EMG recording show pickup areas considerably broader than the muscles directly underlying the electrode site, and thus facial actions signifying emotion may be confused with conversational signals from other muscles. Care should also be used in processing EMG signals to insure that expression dynamics are not obscured by over-averaging of the signals (see Fridlund, 1979).

Facial EMG measurement is most applicable when the investigator can specify in advance the emotions and/or facial actions of interest, when unobtrusiveness is not crucial, and when the subject is not called upon to move the face or body excessively. EMG is probably most useful in the structured imagery and reminiscence tasks described above. Facial EMG may also be the only method of ascertaining whether patients with major affective disorders show chronic facial behavior which is too weak to be visible.

To date, facial EMG techniques have been used to study affective imagery and mood states (Brown & Schwartz, 1980; Carney, Hong, O'Connell, & Amado, 1981; Fridlund, Schwartz, & Fowler, 1984; Oliveau & Willmuth, 1979; Schwartz, Brown, & Ahern, 1980; Schwartz, Fair, Mandel, Salt, & Klerman, 1976a,b; Schwartz, Fair, Mandel, Salt, Mieske, & Klerman, 1978; Teasdale & Bancroft, 1977; Teasdale & Rezin, 1978); posed expressions (Rusalova, Izard, & Simonov, 1975; Sumitsuji, Matsumoto, Tanaka, Kashiwagi, & Kaneko, 1967, 1977); and social interaction and empathy (Cacioppo & Petty, 1979; Englis, Vaughan, & Lanzetta, 1982; Vaughan & Lanzetta, 1980, 1981). Facial EMG research on "depression" (usually measured only by self-report inventory) suggests that EMG may usefully quantify dysphoria. Its relevance for DSM-III major affective disorder is unknown.

RECOMMENDATIONS FOR RESEARCH ON FACIAL BEHAVIOR AND AFFECTIVE DISORDERS

Analyzing facial behavior in major affective disorder patients can uncover new phenomena about affective disorders, and substantiate clinical inferences regarding their relationships with emotion. Such research may enable refinement of diagnosis and more accurate measurement of treatment effects and clinical improvement. Comprehensive measurement (both direct measurement and open-ended observation) is a priority for initial research. It is more costly at the outset, but it is the only way to discover exactly which facial behaviors are most relevant to affective disorders. It may be the most cost-effective in the long run. Selective measurement approaches have a rightful place in follow-up research.

Another priority is determining how various types of standardized tasks compare to structured interviews in eliciting facial behavior useful for diagnosing and charting the course of affective disorders.

Specific attention should be directed toward measuring what we term expression dynamics (especially facial action timing) to determine whether there are patterns that characterize affective disorders but not emotions, moods or traits. Basic psychophysical studies using facial behaviors and observer judgments are needed to ascertain what configurations and dynamics are necessary for ascription of the terms "mood," "trait," or "disorder." This type of research can discover naturalistically how clinicians already assess emotion in affective disorders, and it will enable better clinical training in discriminating affective phenomena in and apart from affective disorders.

There is considerable clinical speculation regarding the psychodynamics of depression. Analytic theorists have posited retroflected anger and lowered self-esteem in the etiology. Learned helplessness accounts suggest that incipient coping attempts are neutralized by anticipation of defeat and futility of action. These hypotheses may be tested by examining the fleeting "micromomentary" expressions (Ekman & Friesen, 1969) that indicate transient affects and which can only be detected using detailed facial coding procedures. For example, the retroflected anger account might predict that the depressed patient would show micromomentary anger, contempt or disgust signals immediately followed by signals of guilt, fear or shame. Regardless of whether these signals were micromomentary in nature, the sequencing of emotional expressions in major affective disorders might decode underlying psychodynamics.

We reiterate our concern that studies of facial behavior in affective disorders parse conversational from emotional signals. This will allow separate assessment of predominance of emotion in affective disorders from the social disengagement (or hyperengagement) seen in such patients.

Recommending that practitioners measure facial behavior is premature. The task is still too costly. Answers must first be obtained to questions we have raised about eliciting, selecting, and sampling facial behavior in the ways most useful for diagnosis and therapy. The measurement tools are ready, the questions are posed, and the answers can be found in the near future. A conjecture about what may then result follows.

A GLIMPSE OF THE NOT TOO DISTANT FUTURE

The last item on the standardized intake questionnaire tells Ms. R to turn on the TV set, and put on the headphones. A series of six one-minute films, each evoking a different emotion, appears on the screen. After each film Ms. R is instructed to rate how she felt while watching each film. After the last film rating, Ms. R hears a brief burst of white noise.

The videocamera mounted in the video monitor transmits her facial expressions to a video digitizer/frame grabber. A pattern recognition program sorts the resulting pixel representation of her facial movements into action units. SQUID (superconducting quantum interference device) sensors monitor her heart rate, brain waves, and respiration remotely. A thermal camera records changes in her facial blood flow and skin temperature. A mathematical pattern classifier (see Fridlund et al., 1984) integrates these data to yield the facial/autonomic pattern and strength of response to each emotional challenge, calibrated against Ms. R's general arousal measured during startle. This output, combined with an endocrine panel and polysomnogram, provides a profile of affective status. A computerized expert system suggests numerically probable diagnoses and treatment options.

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