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The Role of Facial Response in the Experience of Emotion: More Methodological Problems and a Meta-Analysis

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A recent review of the facial feedback literature by Laird (1984) suggested that the effect of facial movement on self-reported mood is large and consistent. In this article, two issues are discussed that suggest that these conclusions are unwarranted. First, methodological problems concerning the facial expressions used to represent valid analogs of emotion and the arousal value of the emotion-eliciting stimuli seriously bring into question the adequacy of the studies to test facial feedback as implied by Izard (1971, 1977) or Tomkins (1962, 1963). Second, even if one accepts the studies designed to represent tests of the effect of facial behavior on self-reported mood, Laird's (1984) box-score approach cannot provide an estimate of the magnitude of the effect. Using meta-analytic techniques (Hunter, Schmidt, & Jackson, 1983; Rosenthal, 1984), I show that the effect size of facial behavior on self-reported mood is actually only of small to moderate value and is most likely an inflated estimate. I conclude, on the basis of the evidence presently available, that the effect of facial feedback on emotional experience is less than convincing.

The facial feedback hypothesis, which states that facial expressions provide feedback to the expresser that is either necessary or sufficient to affect emotional experience, has received considerable attention, in large part because of the growth of research on nonverbal behavior. Such studies have evolved from the writings of Darwin (1872), who argued that emotional processes are directly and intimately related to expression. The importance of these studies to theories of emotion can be seen in the works of such authors as Plutchik (1962), Tomkins (1962, 1963), Izard (1971, 1977), and Ekman (Ekman, Friesen, & Ellsworth, 1972).

A central issue of facial feedback concerns the degree to which facial expressions contribute to emotional experience as opposed to other sources. In a recent evaluation of the facial feedback literature, Laird (1984) divided studies into two types: those that used muscle-by-muscle experimenter-induced facial movements and those that used exaggerate/suppress instructions to alter naturally occurring facial movements. Using a box-score approach, Laird found that the hypothesis was supported 10 to 1 for published studies using the first paradigm and 6 to 1 for those using the second. He concluded that the evidence that refuted the hypothesis was weak and that "facial feedback does occur and, in fact, is a major component of normal emotional processes" (p. 916).

Laird's conclusions are unwarranted for several reasons. As Winton (1986) pointed out in his recent review, with the exception of the Tourangeau and Ellsworth (1979) study, the self-report measures used as dependent variables in most facial feedback studies have not assessed different categorical emotions with similar valence (e.g., anger and fear). Because the dependent variables in these experiments are often dimensional and because researchers cannot control for each subject's degree of fluency with the language of emotion, the facial feedback hypothesis as implied by theorists such as Izard (1971, 1977) and Tomkins (1962, 1963) remains largely untested.

There are two other issues, however, on which this article focuses. First, methodological problems concerning (a) the quality of the facial expressions used to represent valid analogs of emotion and (b) the arousal value of the emotion-eliciting stimuli plague the studies cited by Laird (1984) and, thus, limit inferences concerning the facial feedback hypothesis. I will examine these issues closely and show that conclusions supporting facial feedback are unwarranted according to the evidence currently available.

Second, even if one accepts that the characteristics of these studies give information concerning the effects of facial behavior on self-report, the box-score approach cannot estimate the magnitude of this effect. Our considerations of the role of facial feedback may vary according to the effect size attributed to facial expressions on subjective state. Using meta-analytic techniques, I will show that the magnitude of the effect size, which is based on the studies reviewed by Laird (1984), is actually only of small to moderate value.

Quality of Facial Expressions to Represent Valid Analogs of Emotion

Adequate tests of the facial feedback hypothesis require expressions that represent valid analogs of emotion. I raise five issues that suggest it is impossible to know whether the expressions that subjects made were indeed recognizable as emotional

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expressions, thus rendering conclusions concerning the facial feedback hypothesis unwarranted. Some of these issues have previously been introduced (cf. Hager & Ekman, 1981) with regard to a study conducted by Tourangeau and Ellsworth (1979). A more detailed discussion of these issues, which suggests that most studies of facial feedback suffer from the same methodological handicaps, follows.

Expressions May Not Be as Distinctive as Those Originally Intended

In muscle-by-muscle induction studies, subjects are typically requested to innervate certain facial muscles that are considered to express emotion. No study, however, has reported whether the muscle movements obtained were exactly the same as those requested. An expression must meet certain criteria of type and number of muscle innervation to be accurately called an emotion (cf. Ekman & Friesen, 1975). For example, Laird (1974) asked subjects to perform an "angry" expression by pulling their brows down and together and clenching their teeth. If one accepts Ekman and Friesen's (1975) facial muscle criteria for an angry expression, the expression resulting from these instructions does not produce an angry expression because there is no tensing or widening of the eyes or tensing and pursing of the lips or dropping of the jaw and baring of the teeth. Thus, it is questionable whether this expression is an accurate representation of anger.

The "smile" instructions used in most muscle-by-muscle induction studies also may not produce an expression that is representative of happiness. That is, simply requesting subjects to pull their lip corners up does not meet the minimal criteria for a happy expression because happy expressions are accompanied by a tensing of the muscles around the eyes (Ekman & Friesen, 1982). Thus, questions concerning expression validity remain even in what may appear to be the simplest expression to request.

A related issue concerns the interaction of the expressions requested with those that subjects may bring into the experimental session. Although most studies have taken measures to obtain baseline ratings on self-reported emotion, which enables researchers to measure change in emotional experience, no study has reported a similar control procedure for the requested expressions. The effects of expressions that subjects bring with them into the experimental session must be controlled for in order to examine the effects of the *requested* expressions on change in emotional experience.

Independent coding of the exact facial muscle actions produced in both the muscle-by-muscle induction studies and the exaggeration/suppression studies would have provided a clear picture of (a) whether the facial actions requested were actually produced, (b) whether the expressions lacked necessary muscle movement, (c) whether the expressions contained extraneous muscle movements, and (d) whether the expressions were performed above and beyond those already present. Obtaining data from a separate judgment procedure that uses the requested expressions as stimuli does not provide such accurate information. As it stands now, there is no way to verify that the expressions produced by subjects in either type of experiment included the type and number of facial muscles generally accepted to represent emotion.

Intensity of Muscle Movements

Facial expressions must also meet certain criteria with regard to the degree or intensity of muscle innervation in order to be called emotional expression. For example, the pulling down of the lip corners and the pushing up of the chin boss in sad expressions needs to be at a low intensity to give the appearance of true sadness; when the intensity of these movements is large, the expression changes from sadness to one of pouting, which is not considered an emotion (cf. Ekman & Friesen, 1975). No study has reported that the expressions tested met any intensity criteria; thus, conclusions concerning the facial feedback hypothesis, which pertains to expressions of emotion, are still unwarranted.

Duration of Expression

Ekman (1984) has suggested that emotional expressions have a characteristic *time envelope,* which lasts somewhere between ½ and 4 s. In studies of facial feedback, criteria concerning the length of time that an expression is held on the face need to be applied in order to ensure that the expression is a valid analog of emotion. At least in the muscle-by-muscle induction studies, subjects were typically asked to keep their expressions on the face for an unnaturally long period of time, ranging from 15 s (e.g., Duncan & Laird, 1980; Laird, 1974; Laird, Wagener, Halal, & Szegda, 1982, Study 1; McArthur, Solomon, & Jaffe, 1980) to several minutes (e.g., Laird et al., 1982, Study 2; Rhodewalt & Comer, 1979; Tourangeau & Ellsworth, 1979). Feedback from unnaturally long expressions could be discounted by the subject, which would work against the hypothesis, or it might be stronger and more obvious than feedback from natural expressions, which would lead to an inaccurate confirmation of the hypothesis (Ekman & Oster, 1979). In either case, the validity of the expressions produced in these studies to represent valid analogs of emotion is seriously questioned and limits conclusions drawn from the facial feedback hypothesis.

Expressions Can Change Over Time

There is a possibility that expressions produced at the beginning of a trial may change over the course of the trial, thus changing the emotional interpretation of the expression. The expression can change on several dimensions. For example, requested muscle movements that were necessary for the emotional expression could disappear from the expression, or unnecessary and extraneous muscle movements could be added into the expression. The intensity level of certain muscles may change, which would alter the meaning of the original expression. In exaggeration/suppression studies, expressions produced in response to a stimulus in one trial may be different from the expressions produced in another trial. Because no study has reported procedures to control these possible limitations in terms of independent coding of facial behavior across time within trials, it is difficult to assess the validity of the expressions produced to represent emotional expressions. Again, conclusions concerning facial feedback are unwarranted.

Method of Facial Manipulation

Laird (1984) delineated two types of studies on the basis of the methods used to induce facial expressions: the muscle-by-muscle induction paradigm and the exaggeration/suppression paradigm. In the former, facial expressions are produced by experimenter-directed muscle-by-muscle facial action. It is not clear, however, whether this method produces expressions that are adequate representations of naturally occurring, spontaneous emotional expressions. On the one hand, there is evidence suggesting that production of facial expressions through experimenter-directed facial actions activates distinct and differentiated autonomic nervous system activity for certain emotions (Ekman, Levenson, & Friesen, 1983). On the other hand, there is little data to support the contention that such manipulation produces distinct changes in categorical emotional responses. Also, there is evidence that voluntary facial expressions are under neural control separate from that of involuntary facial expressions (cf. Ekman, 1980), which further suggests that such facial manipulations are not adequate representations of spontaneous emotional expressions.

In the second paradigm, facial expressions are manipulated by having subjects either exaggerate or suppress their reactions to emotion-arousing stimuli. In this procedure, subjects consciously or voluntarily attempt to alter their own naturally occurring or involuntary expressions. Again, it is not clear whether facial manipulation through this paradigm produces valid representations of emotional expression. Both procedures introduce a degree of artificiality on the production of facial expressions, which raises questions as to whether the expressions represent valid analogs of emotional expressions implied by facial feedback theorists.

Arousal Value of Stimuli Used

A wide range of stimuli has been used to test facial feedback, including films (Tourangeau & Ellsworth, 1979; Zuckerman, Klorman, Larrance, & Spiegel, 1981), odors (Kraut, 1982), shock (Colby, Lanzetta, & Kleck, 1977; Kleck et al., 1976; Kopel & Arkowitz, 1974; Lanzetta, Cartwright-Smith, & Kleck, 1976), and slides (McArthur et al., 1980). In order for the facial feedback hypothesis to be adequately tested, care must be taken to ensure that the stimuli used arouse only the emotion intended. In cases where shock was used (e.g., Colby et al., 1977; Kleck et al., 1976; Kopel & Arkowitz, 1974; Lanzetta et al., 1976), it is questionable as to whether the experiential and expressive responses represent valid tests of the facial feedback hypothesis, inasmuch as pain is rarely considered an emotion by major theorists (e.g., Izard, 1971, 1977; Tomkins, 1962, 1963). In cases where the stimuli were more clearly identified as emotion arousing, there is still a question as to whether they arouse only the emotion intended or whether they arouse a blend of different emotions. Although researchers have dealt with facial expressions that depict single categorical emotions and have used rating scales identified by separate emotions, it is very difficult to obtain stimuli that arouse only a single categorical emotion. Because there are questions about the arousal value of the stimuli used, conclusions concerning facial feedback based on the evidence available are again unwarranted.

Assessing the Degree to Which Facial Expressions Contribute To Emotional Experience

The previous discussion suggests that because of limitations regarding the quality of the requested expressions to represent valid emotion and the arousal values of the stimuli used, conclusions concerning facial feedback are unwarranted on the basis of the evidence available at present. The second question raised addresses another point: How large is the role of facial feedback on self-report in the studies to date? Laird (1984) used a box-score approach to conclude that facial feedback is a major component of normal emotional processes. The box-score approach, however, cannot estimate the magnitude of the effect of facial response on self-report.

The question of magnitude of effect size can be addressed by meta-analysis (Hunter, Schmidt, & Jackson, 1983; Rosenthal, 1984). This technique provides the method by which one can address the question of to what degree facial expressions influence, explain, contribute to, or account for differences in subjective mood ratings. There are three advantages to using the meta-analytic approach rather than the box-score approach used by Laird (1984).

First, meta-analysis allows one to compute overall effect size, in this case to estimate the magnitude of the effect of facial manipulation on self-report across all studies. Thus, one can estimate whether facial movement does indeed have an effect on one's emotional experience, and one can estimate the relative size of the effect. Laird (1984) used omega-square (Hays & Winkler, 1971) to estimate a range of effect sizes between .12 and .44 in some selected studies. Also, at least one other study (Kleinke & Walton, 1982) provided information about the magnitude of effect size. Of course, with such limited information, it is impossible to make an adequate assessment of true effect size across studies. Meta-analysis provides the technique for integrating the effect sizes across all studies to adequately assess the true effect size.

Second, effect-size estimates vary across studies. Meta-analysis allows one to investigate whether identifiable sources of error that are common to all studies contribute to this variability. These sources include sampling error, restriction in range, reliability of measurement, computational and typographical error, and amount and type of criterion contamination.

Finally, when the range of effect sizes across studies incorporates a large amount of unaccounted variability, meta-analytic procedures allow for a direct examination of other sources of error that may moderate the effect size. In facial feedback research, such sources of error include duration of expression, type of emotion tested, type of dependent variable, method of facial expression manipulation, and so forth. Should unattributable variance exist in the distribution of effect sizes across studies, meta-analytic procedures can directly examine the relation between each of these sources of error and the magnitude of effect sizes reported across all studies, and they can provide an estimate of this relation. Depending on the nature of these relations, separate meta-analyses can then be performed for the different levels of each moderator.

Method

Description of the Data Set

The data set consisted of the 18 published articles identified by Laird (1984) as directly testing the facial feedback hypothesis. Because the

Table 1
Estimates of Effect Size (in Pearson r) and Sample Size for Each of the 16 Studies

Study	N^a	r
Kopel & Arkowitz (1974)	15	.5490
Laird (1974), Study 1	38	.4048
Laird (1974), Study 1	16	.2309
Laird (1974), Study 2	26	.2244
Lanzetta, Cartwright-Smith, & Kleck (1976), Study 1	18	.2682
Lanzetta et al. (1976), Study 3	20	.6380
Duncan & Laird (1977)	40	.3269
Rhodewalt & Comer (1979)	15	.3486
Tourangeau & Ellsworth (1979)	32	.0000
Duncan & Laird (1980)	60	.5536
McArthur, Solomon, & Jaffe (1980), Study 1	60	.2829
McArthur et al. (1980), Study 2	80	.3293
Zuckerman, Klorman, Larrance, & Spiegel (1981)	16	.2786
Kleinke & Walton (1982)	12	.5867
Kraut (1982)	57	.4216
McCaul, Holmes, & Solomon (1982)	27	.0511

[a] The N reported is the number of subjects in each of the comparison groups used and may not correspond to the total N reported by each of the studies.

present study was only concerned with the effects of facial manipulation on self-reported mood, several studies were excluded from the analyses because they used dependent variables other than self-reported mood, such as physiological response (e.g., skin conductance). Studies involving only indirect observation of facial expression were also excluded. Finally, several studies that mentioned the facial manipulation and collection of self-report data but failed to report the statistics relevant to the facial feedback hypothesis were excluded. This resulted in a final list of 11 published articles. Because several articles reported more than one study, a total of 16 independent studies were used in the meta-analysis (Table 1).

Computation of Effect Sizes

To produce a measure of effect size, each F and t statistic testing the facial feedback hypothesis was transformed into a Pearson r, according to the procedures outlined in Hunter et al. (1983) and Rosenthal (1984). Most of the studies entered into the meta-analysis reported more than one test of the hypothesis, which resulted in multiple effect-size estimates from single studies. Owing to the small number of studies entered into the analyses, the use of these effect-size estimates was not justified because of nonindependence. Thus, a mean effect size for each study was computed, using the procedures outlined by Rosenthal (1984), across all tests of the hypothesis reported by that study. Within each study, each Pearson r was converted by using Fisher's r- to -z transformation. The mean of the Fisher's zs for that study was then computed and transformed back into a mean Pearson r. These procedures allowed 16 independent estimates of effect size to be included; the total sample size across all 16 studies was 532, and the range of the observed rs was .000 to .638 (Table 1).

Procedure

The analysis followed the model and procedure outlined by Hunter et al. (1983). According to this procedure, several sources of error variance can be identified, including error variance owing to sampling error, restriction of range, unreliability of measurement, computational and typographical errors, criterion reliability, and differences between studies in type and amount of criterion contamination and deficiency.

The data available for the present study allowed only for an analysis of the effects of sampling error on the total variance observed in the sample of effect sizes. Briefly, both the total variance of the distribution of effect sizes (S_r^2) and the variance attributable to sampling error (S_e^2) alone were computed. The variance attributable to sampling error was then subtracted from the total variance, which produced an index of the residual variance (S_p^2) and, thus, the residual standard deviation (S_p). It has been suggested that whenever 75% or more of the total variance is accounted for by sampling error (or other artifacts), hypotheses concerning the effects of possible moderator or "third" variables can be rejected (Hunter et al., 1983). If, however, sampling error accounts for less than 75% of the total observed variance in effect sizes, an investigation of possible moderator variables (e.g., method of facial manipulation, duration of facial expressions, etc.) would be warranted.

Results

Across all studies, the mean effect size corrected for sampling error was .343. The variance of the distribution of observed effect sizes was .025, and the variance attributable to sampling error was .023, which produced a residual variance and standard deviation of .002 and .040, respectively. Thus, 93.74% of the total variance in the distribution of observed effect sizes was accounted for by differences in sample size alone. On the basis of the 75% decision rule (Hunter et al., 1983), one can interpret variation in the magnitude of effect sizes across all facial feedback studies included (from .000 to .638) as a function of sampling error.

One can be sure that the overall relation between facial manipulation and self-reported emotion was positive because (a) all studies reporting an effect reported it in the predicted direction; (b) the studies that failed to report an effect did not report that the effect obtained was in the opposite direction, which produced a mean effect size of .000; (c) the obtained effect size corrected for sampling error was more than two standard deviations above .000; and (d) the 95% confidence interval of the mean effect size was .266 to .421.

More than 93% of the variation in effect-size estimates observed across the 16 studies was accounted for by sampling error. Hunter et al. (1983) indicated that in cases in which variation in effect sizes is mostly accounted for by sampling error, any apparent moderating effect is due to capitalization on chance. Therefore, I was not allowed to examine whether effect size estimates vary as a function of such variables as duration of facial expression, method of facial manipulation, type of emotion tested, type of dependent variable used, and so forth.

Discussion

The meta-analytic procedures indicate that the effect of facial manipulation on self-reported emotional experience is of moderate value (.343). This suggests that across all facial feedback studies analyzed, only 11.76% of the total variance in self-reported mood can be attributed to the facial manipulation procedures. Furthermore, this value is most likely inflated because most journals do not publish negative results; consequently, a more reasonable estimate of effect size is probably smaller. On

the one hand, these results do show an effect of facial expression on self-report, which is in general agreement with Laird's (1984) box-score count. On the other hand, these results also suggest that Laird (1984) overestimated the magnitude of these effects and that the effects are only of small to moderate value.

Despite variations in the methodology and quality of the studies reviewed by Laird, all studies were entered in the meta-analysis. Studies could have been screened for their inclusion on the basis of methodological differences (e.g., method of facial manipulation, as Laird delineated) or judged quality. The heterogeneity of designs and approaches could be said to strengthen the power of the observed effect size; yet, it is difficult to sort out factors that may contribute to this effect. I opted to include all studies initially, however, with the following logic. The meta-analytic approach that I used first allows for an examination of whether variability in effect sizes across studies is related to sampling error or to other sources of common methodological error. If a large amount of residual variability in effect sizes across studies remains even after variability attributable to sampling error is subtracted, then one can begin to look for other third or moderator variables that contribute to the variability in effect size. Because a large proportion of the variance in effect sizes was accounted for by sampling error, I could not investigate the possible effects of differences attributable to method of facial manipulation, duration of facial expression, type of emotion tested, and so on. When sampling error accounts for a large percentage of variability, any investigation of moderator variables capitalizes on chance (Hunter et al., 1983). Thus, I was left with interpreting that across all studies with differing methodologies and quality, the mean effect size was .343, and variability in effect size across studies was due, in most part, to sampling error.

A possible implication for emotion theory that one may infer from these results concerns the contribution of facial expressions to emotional experience relative to contributions from other sources. Buck (1980), for example, has asserted that facial expressions contribute something to emotional experience but that this contribution is relatively less important than visceral/autonomic feedback. I caution against this interpretation, however, because there is no standard for comparing the relative influence of one source with another. Visceral/autonomic feedback might well account for an even smaller proportion of variance in self-report than does facial expression. Future studies should be designed to directly compare the effects of both sources.

When considering the meta-analysis results in conjunction with the earlier discussion of methodological limitations of facial feedback research to date, one can conclude the following: (a) The requested facial expressions in the facial feedback studies reviewed probably do not meet the criteria necessary for them to be called emotional expression; consequently, the studies do not represent accurate tests of the facial feedback hypothesis implied or explicit in the writings of Darwin (1872), Tomkins (1962, 1963), or Izard (1971, 1977). (b) There are questions concerning whether the stimuli used in previous studies unambiguously arouse emotions and, if so, whether they arouse only single categorical emotions. (c) Finally, even if one accepts that the studies to date provide some information about the effects of facial manipulation on self-report, the magnitude of this effect is considerably smaller than what one might assume on the basis of Laird's (1984) conclusions.

I suggest that if one is to test adequately the facial feedback hypothesis, the expressions produced in the experimental situation must meet established criteria concerning what constitutes emotional expression. Facial measurement techniques that not only categorize facial expressions but also describe the intensity of the expression, such as the Facial Action Coding System (Ekman & Friesen, 1978), would enable researchers to meet the criteria that I discussed earlier. Using such a measurement system would also allow researchers to measure naturally occurring emotional expressions rather than forcing subjects to consciously alter their expressions.

Researchers also need to carefully select their emotion-arousing stimuli so that to that best extent possible, only single categorical emotions are aroused. Clearly, if it is ambiguous as to whether a stimulus arouses true emotion or not, or if it arouses more than one emotion, then inferences concerning facial feedback are severely restricted.

These efforts may provide more accurate tests of the facial feedback hypothesis, and they may change our considerations of the importance of facial expression on emotional experience. However, on the basis of the experimental paradigms used to date, the contribution of facial feedback to emotional experience is less than convincing.

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