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Inhibiting and Facilitating Conditions of the Human Smile: A Nonobtrusive Test of the Facial Feedback Hypothesis

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We investigated the hypothesis that people's facial activity influences their affective responses. Two studies were designed to both eliminate methodological problems of earlier experiments and clarify theoretical ambiguities. This was achieved by having subjects hold a pen in their mouth in ways that either inhibited or facilitated the muscles typically associated with smiling without requiring subjects to pose in a smiling face. Study 1's results demonstrated the effectiveness of the procedure. Subjects reported more intense humor responses when cartoons were presented under facilitating conditions than under inhibiting conditions that precluded labeling of the facial expression in emotion categories. Study 2 served to further validate the methodology and to answer additional theoretical questions. The results replicated Study 1's findings and also showed that facial feedback operates on the affective but not on the cognitive component of the humor response. Finally, the results suggested that both inhibitory and facilitatory mechanisms may have contributed to the observed affective responses.

Research on the role of peripheral physiological reactions in the experience of emotion has placed its main emphasis on the influence of facial muscular activity. A great number of studies have dealt with whether and how people's facial expressions influence their affective experience. The basic hypothesis of these studies is derived from Darwin's (1872) early contention that an emotion that is freely expressed by outward signs will be intensified, whereas an emotion whose expression is repressed will be softened (p. 22). In other words, Darwin suggested that in the presence of an eliciting emotional stimulus a person's emotional experience can be either strengthened or attenuated depending on whether it is or is not accompanied by the appropriate muscular activity.

Darwin's statement is the predecessor of the current facial feedback hypothesis. Although distinctions were made among several variants of this hypothesis (e.g., Buck, 1980; Winton, 1986), its core is the "causal assertion that feedback from facial expressions affects emotional experience and behavior" (Buck, 1980, p. 813).

The effects of facial activity have been investigated by using three classes of dependent variables: self-reports, recall measures, and autonomic indexes. Typically, it has been found that (a) facial expressions influence affective self-reports and ratings of affective stimuli in the direction of the hedonic value of the expressed emotion (e.g., Laird, 1974); (b) emotional facial expressions improve the recall of hedonically consistent material (Laird, Wagener, Halal, & Szegda, 1982); and (c) facial expressions have autonomic consequences, such as changes in heart rate, skin temperature, skin conductance, and blood volume (e.g., Ekman, Levenson, & Friesen, 1983; McCaul, Holmes, & Solomon, 1982; Zuckerman, Klorman, Larrance, & Spiegel, 1981).

Although reviews of this research differ in their assessment of the presently available results (cf. Buck, 1980; Laird, 1984; Winton, 1986), there seems to be agreement with the conclusion that "facial feedback has a small but reliable moderating effect on the emotional experience and on the evaluation of emotional stimuli" (Kraut, 1982, pp. 861f). No agreement exists, however, on how people's facial expressions influence their emotional reactions.

Two classes of mechanisms have been proposed as possible mediators. Some theorists hold that cognitive processes are responsible for the effect. Laird (1974), for instance, assumed that a self-perception mechanism underlies the facial feedback phe-

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nomenon. According to this view, people who perceive themselves to be smiling infer that they are probably happy, whereas people who perceive themselves to be frowning infer that they are probably sad.

A second group of theorists (e.g., Ekman et al., 1983; Izard, 1977; Tomkins, 1962, 1979) hold that cognitive mediation is not necessary for the facial feedback effect to occur. According to these theorists, physiological mechanisms may be sufficient to generate the affective reactions. From this perspective, a facial expression may affect people's emotional experience without them being aware of their expression.

Facial Simulation Procedure

The facial feedback hypothesis has typically been tested by inducing subjects to simulate facial expressions that represent particular emotions and then measuring their emotional states. This technique was introduced by Laird (1974), who used a cover story about measuring facial muscular activity and attached surface electrodes to subjects between their eyebrows, at the corners of their mouths, and on their jaws. Then a set of the electrodes was touched and subjects were asked to contract their muscles at these points. By using this procedure, Laird was able, without ever mentioning an emotion or an emotional expression, to induce subjects to either smile or frown. He found differences in the subjects' reported moods and in their funniness ratings of cartoons. Specifically, subjects in the smile condition reported feeling happier and rated cartoons as funnier than did subjects in the frown condition.

This facial simulation procedure, or variants of it, has frequently been used to investigate the effects of facial feedback. Unfortunately, however, ambiguities associated with that methodology have clouded the theoretical implications of the findings that have been obtained. More specifically, the facial simulation procedure may not effectively prohibit subjects from recognizing the emotional meaning of the manipulated facial activity. On the basis of this possibility, the issue has been raised whether subjective responses produced by the facial simulation procedure may have been the result of situational demands (cf. Buck, 1980; Ekman & Oster, 1982; Zuckerman et al., 1981). In his original studies, Laird (1974) assessed subjects' awareness of the experiments' purpose. As a result, 16% of the subjects in the first experiment and 19% of the subjects in the second experiment indicated awareness of the relation between the manipulated expressions and their feelings and had to be excluded from the analysis.

Even if motivational influences to act in a manner consistent with the facial feedback hypothesis can be avoided, there is a second way in which the recognition of the emotional meaning of one's facial expression may affect subsequent ratings (cf. Winton, 1986). Research on category accessibility (e.g., Higgins, Rholes, & Jones, 1977; Srull & Wyer, 1979) as well as on priming of emotion categories (cf. Bower, 1981; Clark & Isen, 1982) suggests that the recent activation of such a category (e.g., to interpret one's facial activity) may render this and semantically related categories, as well as related episodic information, more accessible for later use.

In sum, the facial-posing procedure leaves open the possibility that the experimentally induced facial activity can be interpreted in emotion categories and that this interpretation, by itself and in combination with motivational influences, may confound the operation of direct physiological feedback.

It is important to note that autonomic reactions as a consequence of facial expressions do not rule out the possibility of a cognitive mediation. One reason is that physiological changes may follow effortful but nonemotional facial activities such as puffing out the cheeks or closing one eye (Tourangeau & Ellsworth, 1979). So if emotional expressions differ in this respect, it is possible that autonomic reactions are caused by the physical effort they require rather than by the emotional quality of the expression (cf. McCaul et al., 1982).

A second reason why autonomic responses do not rule out cognitive mechanisms is that thinking has been found to be an effective means of modifying physiological responses. Imagining emotionally relevant events influences not only affective self-reports (cf. Strack, Schwarz, & Gschneidinger, 1985) but also autonomic reactions (e.g., Lang, Kozak, Miller, Levin, & McLean, 1980; Miller et al., 1981; Roberts & Weerts, 1982). Findings of physiological changes in response to facial posing do not, therefore, necessarily imply a primacy of physiological processes, nor do they convincingly demonstrate that physiological mechanisms are sufficient to produce the facial feedback effect.

Dissimulation/Exaggeration Paradigm

A line of research conducted by Lanzetta, Kleck, Zuckerman, and their colleagues (e.g., Kleck et al., 1976; Lanzetta, Cartwright-Smith, & Kleck, 1976; Zuckerman et al., 1981) also addresses the facial feedback hypothesis. These researchers induced subjects to suppress or to exaggerate facial expressions in the presence of emotional stimuli such as electric shocks or pleasant versus unpleasant videotapes.

In these studies, subjects' facial muscles were not manipulated into emotional expressions. Rather, subjects were directly asked to modify the expressions they would normally have in response to a stimulus situation. Zuckerman et al. (1981), for instance, instructed subjects in the suppression condition not to reveal by their facial expression which of two videotapes (pleasant vs. unpleasant) they were watching. In the exaggeration condition, subjects were told to "pose appropriate facial expressions" (p. 933) so that observers would be able to identify the presented tape from their faces.

Typically, the instructions to dissimulate or exaggerate facial expressions resulted in corresponding subjective responses and in autonomic reactions. These findings support the facial feedback hypothesis. However, they do not allow a discrimination between physiological and cognitive feedback mechanisms. Zuckerman et al. (1981) admit that "the present procedures do not permit a clear identification of the processes mediating the observed relationships" (p. 942). That is, the facial expressions may have given rise to cognitions ("attributions about affective states," p. 942) which in turn may have affected physiological activity.

Moreover, it is possible that subjects may have used cognitive strategies to support the required facial expressions. For exam-

ple, they may have directed their attention away from the emotional stimulus in an effort to suppress their expression of the emotion elicited by it. Correspondingly, they may have intentionally increased the emotional intensity of their thoughts about the stimulus in order to generate the appropriate emotional expression. Such cognitive mechanisms may have contributed to observed emotional responses.

Methodological Alternative

The main obstacle to precluding possible situational influences and investigating the underlying mechanisms of facial feedback seems to be that the emotional meaning of the manipulated facial expressions is either explicit or can be recognized by the subjects. A procedure that induces subjects to contract muscles associated with certain expressions in a way that does not simulate the expression itself could therefore be an important improvement to the experimental methodology that would help us clarify the processes that mediate the facial feedback effect.

This study is an attempt to provide a clearer test with a new procedure. If the facial feedback hypothesis is assumed to be correct, and if no interpretational mediation is required for the effect to occur, then the inhibition or facilitation of the muscle contractions associated with a particular emotional expression should be sufficient to modify a person's affective experience, even though the muscles are not contracted in the simulation of an emotion-relevant expression. This strategy deviates in important ways from that typically used to test the facial feedback hypothesis. It differs from the facial simulation studies in that no correct expression has to be generated. It requires only that the muscles typically involved in an expression be activated. This strategy also differs from the dissimulation/exaggeration studies in that subjects' facial actions are induced without requiring them to modify an emotional expression. These methodological differences minimize the likelihood that the subjects interpret their facial activity as representative of a particular emotion and therefore use cognitive strategies to modify their emotional experiences.

To create the appropriate facial responses, subjects were induced to hold a pen with their lips only, with their teeth only, or with their nondominant hand. We assumed that holding the pen with the lips only would contract the orbicularis oris muscle. This would be incompatible with contracting the zygomaticus major or the risorius muscles that are used in smiling. Thus, muscle activity associated with smiling would be inhibited. Holding the pen with the teeth only would mainly contract the zygomaticus major or the risorius muscle that is part of the smiling response (cf. Hager, 1982). This would facilitate smiling. Holding the pen in the nondominant hand, of course, would not affect a particular set of facial muscles.

Because a request to hold a pen in one's mouth would certainly stimulate a variety of speculations about the purpose of the experiment, great care was taken to create a situation of high experimental realism (Carlsmith, Ellsworth, & Aronson, 1976). This situation should allow the manipulation of subjects' facial expressions without directing their attention toward their facial activity and without inducing them to associate their facial response with a particular emotion. It appeared possible to accomplish this in an experiment whose ostensible goal was to investigate psychomotoric coordination. Specifically, subjects were told that they were to be in an experiment investigating people's ability to perform different tasks with parts of their body not normally used for those tasks, as injured or handicapped persons often have to do. Subjects were then asked to perform a variety of tasks by holding a pen with their lips only, with their teeth only, or with their nondominant hand. The task of interest was subjects' ratings of the funniness of cartoons.

Pilot testing had indicated that this cover story was plausible and that it succeeded in getting subjects seriously involved in the tasks they were to perform. Thus, we assumed that suspiciousness and demand characteristics were minimized. Moreover, the subjects' attention was directed toward the tasks they were to perform and not toward their own expressions, as in previous studies.

It was hypothesized that more or less positive affective states, as reflected in the experience of humor, would be influenced by muscle contractions associated with smiling. Specifically, potentially humorous stimuli should be rated least funny when the muscles associated with smiling are inhibited (lips condition), but should be rated most funny when this muscular activity is facilitated (teeth condition). With no manipulation of relevant facial muscles (nondominant hand condition), humor ratings should not be affected.

Two studies were conducted to test this hypothesis and to answer related questions. In the first experiment, cartoons were rated under different pen-holding conditions. The second experiment was conducted to replicate the previous findings and to obtain information about the relevant dimensions of the elicited affect and about the relative contribution of inhibiting and facilitating influences.

Study 1

Method

Subjects. Ninety-two male and female undergraduates of the University of Illinois participated in the experiment in partial fulfillment of a course requirement. Subjects were run in groups of 4. After their arrival, the subjects were each assigned a cubicle that prevented communication between the subjects but allowed them to communicate with the experimenter through an open space. On their desks, subjects found a felt-tipped marker 12 mm in diameter, an alcohol swab, and a paper tissue.

Procedure. After the subjects arrived, the experimenter introduced the study with the following words:

> The study you are participating in has to do with psychomotoric coordination. More specifically, we are interested in people's ability to perform various tasks with parts of their body that they would normally not use for such tasks. As an example, you may have seen pictures of physically impaired people who use their mouth to write or use the telephone. Obviously, the ability to do the same task with different parts of their body has important implications for these people. For them, the quality of their future life is greatly dependent on whether they can continue to exercise control over their environment by being able to perform basic tasks by themselves. The tasks we would like you to perform are actually part of a pilot study for a more complicated experiment we are planning to do next semester to better understand this substitution process. The tasks are a sample of a much larger number of tasks, and they

involve very different aspects of psychological functioning. Some of the tasks are related to physical skills, like drawing lines, and others are related to more "normal" mental activities that people with a bodily impairment might do during a typical day, like reading a magazine.

The experimenter went on to explain that several methods of holding a pen other than with one's dominant hand would be tried out. Depending on the experimental condition, subjects were told to hold the pen with the nondominant hand, with the teeth, or with the lips. For reasons of procedural logistics, subjects in the same session were in the same experimental condition.

Before the first task, subjects were told to disinfect the felt pen with the alcohol swab provided. Then, under the lips condition, they were instructed to hold the pen tightly with their lips. It was emphasized that they should not touch the pen with their teeth. In addition, the experimenter demonstrated the correct way to hold the pen, by protruding the lips as shown in the left half of Figure 1. He also demonstrated the incorrect way to hold the pen, by compacting the lips tightly against the teeth. Under the teeth condition, subjects were told to hold the pen with their front teeth. It was emphasized that they should hold the pen gently, without touching it with their lips. Again, the experimenter demonstrated the correct technique (see the right half of Figure 1). Under the nondominant hand condition, the experimenter asked subjects to hold the pen with the hand they would not normally use for writing.

The experimental task consisted of four parts that were printed on separate sheets of paper and presented to subjects in a single booklet. The first task was depicted as a practice task and involved drawing a straight line between two points. The second task, which ostensibly began the experiment proper, involved drawing a line between 10 ordered digits printed randomly about the page. The digits were printed on graph paper to increase the task's face validity. In addition, a 10-point scale was printed on the bottom of this page, and subjects were instructed to indicate on this scale how difficult it was for them to perform the digit-connection task. They were asked to mark the scale holding the pen as they had while performing the task. This difficulty rating was included for two reasons. First, it familiarized subjects with making scale ratings while holding the pen in these positions. Second, we expected that knowledge of the perceived difficulty of the various ways of holding a pen would be potentially useful in discriminating between alternative explanations of any observed effects.

The third task consisted of eight consonants and nine vowels randomly printed on the page. The subjects' task was to underline only the vowels. After doing so, subjects were again asked to rate the difficulty of the task on a 10-point scale printed on the bottom of the page.

The fourth task involved the ratings of main interest. In this task, subjects were told that they would see several cartoons of the type typically found in magazines and that, as usual, some would seem funnier than others. Subjects were asked to rate each on a 10-point scale ranging from *not at all funny* (0) to *very funny* (9). Subjects read and rated each cartoon with the pen held in the original position (i.e., lips, teeth, or nondominant hand). The four cartoons were taken from Gary Larson's series *The Far Side* and had been prerated as being moderately funny ($M = 6.61$).

Pretesting. To ensure that the experimental task and its cover story did, in fact, prevent subjects from interpreting their facial activities in terms of emotion-relevant categories, extensive pretesting was conducted. Twelve subjects similar to those used in the actual experiment were paced through the experimental procedure and intensively interviewed about their perceptions of the experimental situation. The pretesting indicated that the cover story was extremely effective. None of these subjects suspected the actual purpose of the experiment. In fact, even after these subjects were told that the study's goal was not the one that had originally been described to them, their forced guesses contained no reference to either facial expressions or moods. Moreover, after they were informed of the study's actual purpose and explicitly asked whether they had entertained the correct hypothesis at any time during the experiment, all subjects indicated that the only hypothesis they had considered was the one initially provided by the experimenter. This unanimous reaction assured us that the cover story was effective, that the experimental setting did not elicit alternative hypotheses on the part of the subjects, and that the facial activity was not spontaneously associated with a particular emotion.

Results

Funniness ratings. The dependent variables of main concern were the funniness ratings of the four cartoons. Surprisingly, the average rated funniness from the experimental subjects ($M =$ 4.75) was considerably lower than the pretest ratings ($M =$

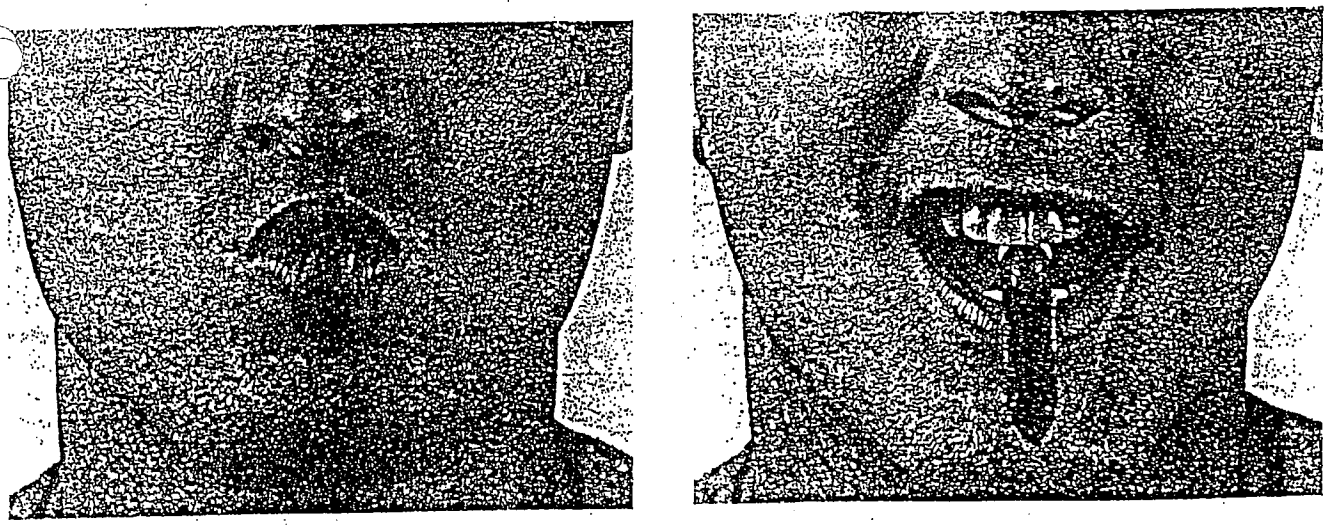

Figure 1. Illustration of the technique used to contract the different facial muscles: left, lips condition; right, teeth condition.

Table 1
Ratings of Funniness and Difficulty: Study 1

Cartoon	Position of pen		
	Lip	Hand	Teeth
First	3.90	5.13	5.09
Second	4.00	4.10	4.19
Third	4.47	4.67	5.78
Fourth	4.90	5.17	5.50
Mean funniness	4.32	4.77	5.14
Mean difficulty	4.47	2.72	4.91

Note. All ratings were made on a scale from 0 to 9, where a lower value stands for lower funniness and difficulty, a higher value for higher funniness and difficulty.

6.61). One reason for this unexpected difference may be found in the divergent ranges of the funniness ratings and the resulting of the response scale. The least funny cartoons in the pretest re far less funny than those in the experiment proper. Consequently, subjects may have adjusted the response scale to accommodate these cartoons and thus assigned higher ratings to the funnier ones than they did in the main experiment (cf. Ostrom & Upshaw, 1968).

On the basis of the facial feedback hypothesis, we predicted that the cartoons would be rated least funny when the activity of the muscles associated with smiling was inhibited (lips condition), but would be rated funniest when this activity was facilitated (teeth condition). Table 1 gives an index of the funniness ratings for the four cartoons and for each cartoon separately. As can be seen, the results clearly support the predictions. Subjects who held the pen with their lips gave the lowest overall ratings ($M = 4.32$), whereas subjects who held it with their teeth gave the highest ratings ($M = 5.14$). The ratings for subjects who held the pen in their nondominant hand fell between these two extremes ($M = 4.77$). The predicted differences were confirmed by a significant linear contrast, $t(89) = 1.85$, $p = .03$.[1]

The predicted pattern proved to be largely consistent for all individual cartoons. As Table 1 shows, all four cartoons were least funny in the lips condition, and three of the four toons (except Cartoon 1) were rated funniest under the teeth ondition. No significant interaction between the experimental conditions and the four cartoons resulted from a mixed-model analysis of variance (ANOVA) treating the cartoons as a within-subjects factor, $F < 1$. Taken together, these findings suggest that inhibiting the muscular activity associated with smiling dampened subjects' experience of humor, whereas facilitating this activity intensified their experience. Although the size of the effect was small, it proved to be quite consistent over the series of stimuli.

Difficulty ratings. One alternative explanation for these findings may be found in the different degrees of difficulty for the three experimental conditions. It could be argued that the more difficult it was for subjects to hold the pen, the more they were distracted from the cartoon's humorous content and the less funny the cartoons were rated. This alternative hypothesis can be tested by looking at the difficulty ratings from the two tasks that immediately preceded the funniness ratings.

The bottom row of Table 1 shows the combined difficulty ratings for the two tasks. As can be seen, there is no correspondence between the pattern of the mean difficulty ratings and the pattern of the rated funniness. An analysis of covariance yielded no significant effect for difficulty as a covariate, $F < 1$. The effects of the independent variable on funniness ratings in this analysis were about the same as when task difficulty was not controlled for. The results clearly indicate that the difference in funniness ratings was not produced by differences in the difficulty of the three experimental conditions.

Study 2

To strengthen the empirical basis of the results and to substantiate the validity of the methodology, a second study was conducted in a different cultural setting. The same pen-holding procedure was used and subjects had the same task of assessing a series of cartoons. However, the second study differed from the first in two important respects. These modifications were introduced to achieve a better understanding of the processes that underlie the observed relationship between holding a pen in a particular way and the differences in the ratings of the cartoons.

First, the question arises as to whether the pen-holding procedure also affects subjects' emotional feelings in the absence of an external eliciting stimulus. Specifically, holding the pen under these different conditions may not only modify an existing emotional experience by inhibiting or facilitating the appropriate facial reaction as proposed by Darwin (1872). It may actually induce emotional feelings that are not elicited by the humorous stimuli, as proposed by James (1890). This is particularly true for the teeth condition, where holding the pen in the experimental position not only permits a smile to occur but at the same time requires the muscles necessary to produce a smile to be contracted. To evaluate this possibility, we varied the point at which the subjects were told to hold the pen in the appropriate position. Half of the subjects held the pen with their lips (or teeth) both when they were presented with the humorous stimuli and when they rated them. The remaining subjects were instructed to hold the pen in the appropriate position only when they gave their ratings.

Three possibilities are theoretically conceivable. First, subjects may use the affect they experience at the time of judgment as information about their feelings toward the cartoons (cf. Schwarz & Clore, 1983). If this is the case and if the pen-holding procedure itself induces different affective reactions, the procedure should influence the ratings in the same direction, regardless of whether it is used at the time of the stimulus presentation

[1] Although subjects were visually isolated and could not communicate with each other, one might argue that the experimental groups constitute the appropriate unit of analysis. Unfortunately, group codings of Study 1 were lost through a clerical oversight. However, an analysis of variance that used sessions as unit of analysis in Study 2 yielded basically the same effects as using the subjects as unit of analysis (see Footnote 2).

or at the time judgments are reported. Second, the pen-holding procedure may enhance or inhibit subjects' feelings toward the cartoons at the time they are presented, and subjects' later ratings then are based on their memory of their emotional reactions. In this case, the effects of the pen-holding procedure obtained in Study 1 should be apparent only if the procedure is used at the time the cartoons are presented and should not be evident when it is used at the time of the judgment alone. Further consideration of this hypothesis raises still a third possibility: Subjects may use the affect they experience at the time of judgment as a standard of comparison in reporting the affect they experienced toward the cartoons presented earlier. If this is the case and if the pen-holding procedure itself elicits affect, using this procedure at the time of the rating may have a contrast effect. Specifically, subjects who hold the pen in their teeth and experience positive affect may report their earlier feelings of amusement to be less, in relation to this standard, than subjects who held the pen in their lips. Study 2 permitted exploration of these possibilities.

Second, a relevant distinction between two aspects of the humor response was incorporated into the experimental design. Gavanski (1986), following Leventhal and his colleagues (Leventhal & Cupchik, 1976; Leventhal & Mace, 1970), differentiated between cognitive and affective components of the humor response. According to Gavanski, the cognitive component is the evaluation of the humor content of the stimulus and the affective component is the reported emotional experience elicited by the humor stimulus. Conventional ratings of funniness, such as those in Study 1, are likely to be based on both components of the humor response, partly because subjects were not permitted to provide ratings that distinguished between the two components. However, if subjects are provided with separate scales that pertain to each component and if subjects' attention is directed toward these different components, a distinction that permits the effects of facial feedback to be localized on the affective dimension seems more likely to occur.

Peripheral physiological reactions to humorous stimuli, however, should be more likely to contribute to the affective component of the humor response than to the cognitive evaluation of the characteristics of the cartoon. Therefore, two measures are used in Study 2 that are differentially sensitive to the affective and cognitive components of the humor response. We expected that the pen-holding procedure would be more likely to influence the affective measure.

As a consequence of these theoretically based variations, several minor additional changes were necessary. Apart from changes in the cover story, cartoons were rated as a group, after they had all been presented, rather than individually. This was necessary in order to vary the point of time at which the pen was placed into the appropriate position. This change was guided by two considerations. First, it seemed difficult and implausible to require the subjects under one condition to change the position of the pen several times in a sequence after the presentation of each cartoon. Second, sequential ratings of several cartoons may induce the raters to make comparative judgments. If this is true, a global rating of several similar cartoons may actually be more sensitive to the influences of facial reactions than are successive individual ratings.

Method

Subjects. Thirty-eight female and 45 male students of Mannheim University participated in the experiment. The number of male and female subjects was approximately the same for each experimental condition. The participants were recruited for a study on motoric coordination and expected to be paid DM 7.00 (approximately $3.40) for their participation. Up to 6 subjects participated in one experimental session.

Experimental design. The experimental design consisted of the factors position of pen (lips vs. teeth), mode of looking at cartoons (with pen vs. without pen in experimental position), and the order in which the two ratings were performed (funniness first vs. amusement first). The three manipulated independent variables of the experimental design were used as orthogonal between-subjects factors in an ANOVA.

Stimulus material. Four cartoons (3 drawn by Jim Unger, 1 by Papan) were used as stimuli. These cartoons had been prerated on the relevant dimensions together with 12 other cartoons from different artists. They were selected because they produced sufficiently high ratings on both component measures (i.e., affective and cognitive) of the humor response and because they were similar enough to permit global ratings.

Procedure. After the subjects arrived, they were assigned to separate cubicles to prevent any contact with their fellow subjects. As in Study 1, they found a felt-tipped pen, an alcohol swab, and a paper tissue on their desks. Then the experimenter began by explaining a problem that had ostensibly been neglected in questionnaire research, namely, that respondents who cannot fill out a questionnaire with their hands because they are physically impaired are typically excluded from experiments. This, of course, would potentially bias the findings. Subjects were told this study was designed in an effort to learn more about a handicapped person's difficulties in filling out a questionnaire. In addition, the study purported to investigate if different response scales would be differentially suitable for handicapped respondents.

To study alternative ways of filling out a questionnaire, half of the subjects were instructed to hold the pen with their lips and half of the subjects were instructed to hold it with their teeth. (The specific instruction and demonstration by the experimenter were the same as in Study 1). To familiarize subjects with the particular pen-holding position, a skill-related task had to be performed. Depending on the conditions, half of the subjects continued with the pen held in the experimental position. The remaining subjects continued with the pen in their hand.

In addition to the two pen-holding positions (lips vs. teeth), the point in time at which the pen was held in this position was varied. Half of the subjects placed the pen in the experimental position when they started filling out the questionnaire. As in Study 1, these subjects looked at the cartoons while they were holding the pen either with their lips or with their teeth. The other subjects held the pen in their hand when they looked at the cartoons. These subjects had been initially informed not to place the pen in the appropriate position before a special instruction to do so showed up in the questionnaire. Subjects under this condition had been instructed to start answering the questionnaire in the usual manner, ostensibly to get used to the questions and scales. To keep the time during which the pen was held in the experimental position approximately the same across conditions, three rather than one skill-related task had to be performed before the beginning of the questionnaire.

The questionnaire began with several attitude questions that had no conceivable relation to the critical rating task. The subjects were then instructed to look at the cartoons and to answer the subsequent questions. After the experiment, the subjects were questioned about possible suspicion. Without an explicit probe, the participants expressed no suspicion about the study's purpose. When probed, few subjects mentioned the possibility that their actual answers to the attitude questions might have been of interest to the experimenter. No subject, however, men-

Table 2
Ratings of Funniness, Amusement, and Difficulty: Study 2

Onset of pen-holding procedure	Position of pen	
	Teeth	Lips
Funniness		
Before stimulus presentation	5.48	5.65
Before rating	4.95	5.68
Amusement		
Before stimulus presentation	6.43	5.40
Before rating	5.05	6.00
Difficulty		
Before stimulus presentation	4.86	4.70
Before rating	4.10	4.23

Note. Ratings of amusement and funniness were made on scales from 0 to 9, ratings of difficulty on a scale from 1 to 7. A lower value stands for lower funniness, amusement, and difficulty; a higher value stands for higher funniness, amusement, and difficulty.

tioned the ratings of the cartoons or considered the actual purpose of the study. Subjects were then fully debriefed, paid, and sworn to secrecy.

Dependent variables. To differentiate between the cognitive and affective component of the humor response (Gavanski, 1986), subjects were asked two questions about the cartoons. The question intended to elicit an evaluative reaction was phrased "How funny do you think these cartoons are if you try to apply an 'objective' standard?" The response scale went from 0 (*I found these cartoons not at all funny*) to 9 (*I found these cartoons very funny*). To tap the affective component of the humor reaction, the subjects were asked "What feeling was elicited in you by looking at the cartoons?" The endpoints of the response scale (0 to 9) were labeled *I felt not at all amused* and *I felt very much amused.* The questions were similar to those of Gavanski's study. To further increase the differentiation in subjects' responses, the two questions were introduced by a statement to the effect that cartoons could be evaluated according to different aspects: (a) how funny they are and (b) how amused one felt looking at the cartoons. It would be the respondents' task to give both ratings in reaction to the cartoons. This introduction was also intended to decrease the possible effects of the order in which the two questions were presented. To control for this effect, the order was varied between subjects. After the ratings of funniness and amusement, the perceived difficulty of the task was assessed and several postexperimental questions were asked, including a question on how successful subjects thought they were in holding the pen in the intended way.

Results

As explained earlier, effects of facial feedback were expected to be localized in the amusement ratings but not in the funniness ratings.

Funniness ratings. As seen in Table 2, subjects' evaluations of the cartoons were hardly affected under the different experimental conditions. The ANOVA showed no significant main effects or interactions, all $ps > .20$.

Amusement ratings. Subjects' reports of their emotional feelings, however, were clearly influenced by the experimental manipulations. Data relevant to these effects are shown in the second section of Table 2. As expected, subjects who held the pen in their teeth at the time the cartoons were presented reported feeling more amused than those who held it in their lips, $t(75) = 1.78$, $p < .05$, one-tailed. This difference confirms Study 1's results. Quite the opposite pattern was evident, however, when the pen-holding procedure was used only at the time of judgment. Here, a contrast effect emerged; that is, subjects who held the pen with their teeth reported having felt less amused by the cartoons than subjects who held the pen with their lips. Although this latter effect only approached significance, $t(75) = 1.65$, $p < .11$, two-tailed, the interaction of procedure (lips vs. teeth) and the time the procedure was used (during stimulus presentation vs. only at the time of the rating) was highly significant, $F(1, 75) = 5.81$, $p < .02$.[2]

Task difficulty. Subjects' ratings of task difficulty were not significantly affected by the experimental manipulations. Although the perceived difficulty was consistently greater when the pen had to be held in the mouth while subjects were looking at the cartoons, the appropriate main effect was not sufficiently reliable, $F(1, 75) = 2.76$, $p > .10$. Overall, difficulty and amusement ratings were virtually unrelated, $r = .006$. (The within-cell correlations ranged from $r = -.16$ to $r = .25$.)

Supplementary analyses. Although task difficulty was obviously not a factor underlying the obtained effects, their interpretation is predicated on the assumption that subjects were successful in using the pen-holding procedure. To provide an indirect indication of the extent of this contingency, subjects were divided into those who were above and those who were below the median in the success they reported with the procedure (subjects rated on a 7-point scale to what degree they succeeded in holding the pen in the appropriate position during the entire experimental session). Subjects who perceived themselves to be successful (ratings above the median of 5) reported feeling more amused by the cartoons when they held the pen with the teeth while the cartoons were presented ($M = 7.40$) than when they held the pen with their lips ($M = 4.70$). However, the corresponding difference was negligible (6.13 vs. 6.10) for subjects who perceived themselves to be unsuccessful. Analogously, successful subjects who held the pen in the experimental position only at the time of the rating reported themselves less amused by the cartoons when they held the pen with their teeth ($M = 4.20$) than when they held it with their lips ($M = 5.80$), but this difference was nonexistent among subjects who thought they were unsuccessful (5.90 vs. 6.17). Thus, the pattern shown in Table 2 was apparent only for subjects who perceived themselves to have been successful using the procedure they were assigned. In future research using these procedures, it may be important to keep this contingency in mind.

Discussion

The findings of Study 2 lend further support to the validity of the pen-holding procedure and specify conditions under which facial feedback is most likely to occur.

[2] When sessions were used as unit of analysis, the statistical reliability of the relevant interaction was maintained, $F(1, 28) = 4.15$, $p = .05$.

First, Study 1's findings—that subjects report stronger emotional feelings in the presence of an emotional stimulus when the appropriate facial reaction is facilitated rather than inhibited—were replicated in Study 2.

Second, the new findings circumscribe the effects of facial feedback on emotional judgments in an important way. Specifically, the pen-holding procedure had an impact on subjects' affective reactions to the cartoons, but did not affect their evaluations of the cartoons themselves. Because the facial feedback hypothesis predicts an impact of facial expressions on one's emotional experiences (e.g., Buck, 1980), this contingency is not unexpected. It is important to note, however, that in Study 1, where subjects were not given the opportunity to differentiate between the two components of the humor response, their ratings of the cartoons were affected by facial feedback. This suggests that subjects' ratings may often be a composite of both cognitive and affective factors unless subjects are induced to distinguish between them.

Third, Study 2's findings help to identify the contribution of inhibitory and facilitatory mechanisms. The fact that the ratings in the lips and teeth conditions of Study 1 deviated to about the same degree from the control group provides evidence that both mechanisms are operating. Study 2's results are consistent with this interpretation. This conclusion is based on the observation that the point at which subjects used the pen-holding procedure (at the time they saw the cartoons or only at the time they made the rating) had even more influence under the teeth condition, where the smile is facilitated (6.43 vs. 5.05; see Table 2) than under the lips condition where the smile is inhibited (5.40 vs. 6.00). Had the teeth condition only been a control group in which smiling was not inhibited, no difference would have been expected as a function of the onset of the pen-holding procedure.

Similarly, the finding that subjects who held the pen in the experimental position only at the time of the rating reported lower amusement with the cartoons under the teeth condition than under the lips condition suggests that the facilitating teeth condition had some influence even in the absence of the emotional stimulus. As mentioned earlier, this contrast effect may have been caused by subjects who used their present affect as a standard for the rating of their affect when they saw the cartoons. Although further research is needed to substantiate these suggestions, it is difficult to account for this observation assuming that only inhibitory processes are operating.

One objection might be that the facial stimulation immediately before the rating lasted longer for subjects who held the pen in the experimental position while both looking at and rating the cartoons than for subjects who placed the pen in the experimental position only after the presentation of the humorous stimuli. This possibility cannot be completely ruled out, although the time the latter subjects held the pen in the experimental position was approximately the same as that of the former because they were given a higher number of skill-related tasks at the beginning. However, it is not entirely clear that the emotional experience is a positive function of the duration of the facial feedback. The opposite position is advocated by Izard (1981) who argues that long-held facial muscle contractions are less likely to have emotional consequences than "micromomentary" expressions (p. 353). Although this issue is still under debate, what effect the duration of the pen holding might have had on the amusement ratings cannot be decided.

General Discussion

The purpose of these studies was to manipulate facial expressions with a new methodology that avoids a cognitive interpretation of the facial action. The results obtained lend additional support to the facial feedback hypothesis. Consistent with the findings of earlier studies, manipulation of the facial activity associated with particular emotional expressions influenced people's affective experiences in the presence of an emotional stimulus. In particular, the rated funniness of cartoons depended on the possibility of producing the muscle action involved in smiling.

In contrast to the methodology of earlier studies, however, the facial manipulations in these studies did not induce the posing of expressions associated with particular emotions. Rather, differential affective reactions were produced by a task that either inhibited or facilitated the facial muscles involved in a smile. Whereas the inhibiting task did not induce the muscle contractions that constitute an emotional expression, the facilitating task allowed a smile to occur and required subjects to contract the muscles necessary to generate a smiling facial expression.

The results of both studies suggest that the affective reaction toward an emotional stimulus was intensified when the facial expression was facilitated and softened (cf. Darwin, 1872) when this expression was inhibited by an irrelevant task. This experimental procedure reduced the likelihood that subjects' attention was directed to their faces and that they interpreted their facial actions in terms of a particular emotional category.

That the evaluation of emotional stimuli was affected under these conditions has theoretical implications for the discussion of potential mediating mechanisms. Our findings suggest that cognitive processes that imply the recognition of the emotional meaning of one's facial expression are not necessary to influence resulting emotional experiences. More specifically, our findings are inconsistent with several mechanisms:

1. *Compliance with experimental demand.* According to this explanation, subjects recognize the study's purpose. To comply with the experimenter's wishes (cf. Orne, 1962), they make judgments that are consistent with the hedonic value of the facial expression that they have been asked to pose. Note that these demand effects depend on the subjects' ability to recognize the purpose of the manipulated facial expressions, which was effectively eliminated in our experiments.

2. *Intentional mood manipulation.* This alternative explanation, like the first, suggests that subjects recognize the study's purpose and try to comply with the experimenter's wishes. Here, however, subjects do not simply make judgments consistent with their manipulated expression, but actively attempt to put themselves into (or take themselves out of) the mood. For example, they may dwell on past positive or negative experiences (cf. Strack et al., 1985). From this perspective, the effects of mood on ratings are only indirectly related to facial expressions. Again, though, this explanation depends on the subjects'

ability to discern the nature of the experiment. As noted previously, our subjects were unable to do this.

3. *Priming of emotion-relevant concepts.* If subjects interpret their facial expressions in terms of an emotional category (i.e., smile or frown), then these and related concepts (e.g., happy or sad) may become more accessible to the subjects (cf. Clark & Isen, 1982). Hence, these concepts, and not a direct feedback mechanism, could mediate the subjects' responses to the cartoons. Activation of the emotion concepts, however, requires that subjects interpret their facial expressions. In these experiments, subjects' attention was directed toward the tasks they were performing, not their facial expressions. This would seem to limit the subjects' ability to activate emotion concepts by interpreting their facial expressions in emotion categories. Moreover, such a mechanism should have affected the amusement ratings under those conditions of Study 2 in which the facial response was induced only at the time the ratings were made. This was not the case.

4. *Self-perception.* This view (cf. Bem, 1967; Laird, 1974) assumes that people use their facial expressions as a source of information to infer their own attitudes: If they are smiling, the joke must be funny. Again, however, in these experiments subjects' attention was directed away from their expressions toward the tasks, and the facial responses were not identical with emotional expressions. Interestingly, a strict application of self-perception theory (Bem, 1967) would not predict a facial feedback effect in this study. Insofar as the subjects' expressions were "manded" by the pen-holding, these expressions were nondiagnostic for the underlying emotion. Hence, subjects should discount their expressions as a basis of inference, perhaps even producing judgments in a direction opposite of that implied by the expression.

Our findings clearly suggest that recognizing the emotional meaning of the facial response was not a necessary precondition for the effect. Rather, it seems that the interplay between an emotional stimulus and an innate motor program (e.g., Leventhal & Scherer, 1987) like the smile is the determinant of the emotional experience. Obviously, more research is needed to understand the exact mechanisms that are responsible for facial feedback. In this endeavor, an alternative methodology that eliminates possible confounds may be helpful.

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