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Differentiating emotion elicited and deliberate emotional facial expressions

URSULA HESS
University of Geneva

and

ROBERT E. KLECK
Dartmouth College
Hanover, NH

Abstract

Recent research suggests the potential importance of dynamic aspects (e.g. speed of onset and offset and degree of irregularity) of facial movement for the encoding of spontaneous versus deliberate emotional facial expressions. The present studies were conducted to investigate whether emotion elicited and deliberate facial expressions of happiness and disgust differ regarding their dynamic features. Two experiments were designed to elicit spontaneous and deliberate facial expressions of happiness and disgust. The experiments differed regarding the deliberate facial expressions, which were either poses (Experiment 1) or masking deceptions (Experiment 2). Experiment 2 confirmed Ekman and Friesen's (1982) notion, that spontaneous expressions have slower onsets and offsets than do deliberate expressions. The data show that dynamic aspects of the facial expressions differentiate between elicitation conditions. However, the evidence was more consistently found for the degree of irregularity of the expression than for the speed of onset and offset.

INTRODUCTION

A topic of continuing interest in the field of nonverbal communication regards the nonverbal indicators of deceptive messages (e.g. DePaulo, Stone, and Lassiter, 1985). In most studies in this field the deception consists of the telling of untruthful messages. Less interest has been given to emotional deception; that is, to the attempt to deceive

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Correspondence concerning this article should be addressed to Ursula Hess, Department of Psychology, University of Geneva, 24, rue Général-Dufour, 1211 Geneva 4.

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an observer regarding one's emotional state, rather than making an untruthful statement. The present research is concerned with differences between spontaneous, emotion elicited, and deliberate emotional facial expressions; specifically with the dynamic features of the facial expressions that might differentiate the two types of displays. Dynamic aspects of the facial expression are features such as the speed of onset and offset, and the irregularity of the expression that refer to the time course rather than the morphology of the facial display.

The terms 'spontaneous' or 'emotion elicited' emotional facial expression are used to refer to unmodulated emotional facial expressions that are congruent with an underlying emotional state, while 'deliberate' expressions are those intentionally employed by the sender for some purpose. The latter include poses, that is expressions shown in the absence of an underlying emotional state, as well as masking or deceptive expressions, that is, emotional expressions that are incongruent with the underlying emotional state (e.g. smiling when one is angry). Phenomena such as pathological laughter and crying, as well as facial gestures (see Ekman, Hager, & Friesen, 1981; Ekman, 1978) are not included in this definition and will not be part of the present investigation.

The area of inquiry most relevant to the present research is concerned with the nonverbal indicators of deceptive messages. Here, the body of research specifically addressing the qualitative differences between spontaneous and deliberate emotional facial expressions, that is, emotional facial expressions employed to deceive an observer regarding the emotional state of the sender, is small compared to the body of research centred on differences in facial expressions found when the sender is telling the truth or is lying. However, some of the basic considerations regarding the nature of deceptive messages in general are of relevance for deliberate emotional facial expressions as well. Zuckerman, DePaulo, and Rosenthal (1981) point to four different sources of markers of deception. First, the voluntary control involved in deceptive behaviour may in itself produce markers of deception. For instance, senders may try too hard to convey a truthful appearing image and may overdo behaviours they think are important. Since some channels are easier to control than others (e.g. Ekman and Friesen, 1969) discrepancies between channels might occur, or the control effort itself may change the expression (see Campbell, 1986). Secondly, the literature on psychophysiological markers of lying (e.g. Lykken, 1979) shows that deception is usually associated with increases in arousal. Nonverbal indicators of arousal, such as blinking, pupil dilation, pitch, speech errors, and speech hesitations might therefore occur in increased frequency when a sender is lying. A third source of deceptive markers are indicators of affective states such as guilt or shame (Kraut, 1980) or 'duping delight' (Ekman, 1980). Generally, neither guilt and shame nor 'duping delight' are likely to occur in the laboratory to a marked degree, but one might assume that most subjects do not like to deceive and might therefore show some signs of anxiety such as less eye contact, less direct body orientation, and more distance from the communication partner (Mehrabian, 1971), as well as a decrease in the use of illustrators (Ekman, 1980). Lastly, it is generally assumed that producing a deceptive message is cognitively more demanding than telling a simple truth. Senders of deceptive messages should therefore show indicators of cognitive effort such as speech pauses, longer response latencies, pupil dilation, and fewer illustrators (Goldman-Eisler, 1968; Kahneman, 1973; Ekman and Friesen, 1972).

DePaulo *et al.* (1985) provide an exhaustive meta-analysis of studies on both verbal and nonverbal markers of deception. Indicators of deception that have been reliably detected in the face are pupil dilation, the use of adaptors, and blinking. Gaze, head movements, and smiling, on the other hand, do not appear to distinguish between honest and deceptive messages.

Ekman and Friesen (1982) speculated that the main difference between spontaneous emotional smiles and deceptive smiles lies in some of the topographical and temporal aspects of these expressions. They suggested and provided some preliminary evidence for the notion that smiles that do not reflect an emotional state are (a) more asymmetrical, a notion that has been supported by Hager and Ekman (1985), (b) have 'socially inappropriate' (short) onset[1] and (irregular) offset[2] times, and (c) are shorter than 2/3 second or longer than 4 seconds. Consistent with this notion is Bugenthal's (1986) finding that adults' smiles had faster offsets when directed at unresponsive children and that adults who attributed their success as care-givers to 'luck' instead of 'ability' showed smiles with faster onsets when smiling at children. The study suffers, however, from methodological problems: (a) smiles were the only 'objective' measure of the affective state; (b) only the lower face component of the smiles were measured; and (c) no attempt was made to control for co-occurring facial actions. Similarly, Weiss, Blum, and Gleberman (1987) investigated some of the temporal differences between posed expressions and expressions elicited by hypnotically induced affect. They found shorter onset times and more irregularities (pauses and stepwise intensity changes) for deliberate facial expressions. However, their study, while interesting regarding the variables they investigated, was based on a sample of only three female subjects who were selected for their hypnotic suggestibility.

In summary, findings by Weiss *et al.* (1987) and by Bugenthal (1986) are consistent with Ekman and Friesen's (1982) notion that spontaneous and deliberate emotional facial expressions should differ in the speed of onset. Further, some evidence is provided by Weiss *et al.* (1987) that spontaneous expressions are less irregular than are deliberate expressions.

The studies described above raise a number of interesting points, however, they also pose a number of problems. All of Ekman and Friesen's as well as Weiss *et al.*'s senders were female. While Ekman and Friesen investigated the role of onset, offset and time at apex, they did not measure irregularities; conversely, Weiss *et al.*, measured only onset times and irregularities. The present studies were designed to systematically investigate the differences between spontaneous and deliberate emotional facial expressions regarding their dynamic aspects. To enhance the generalizability of the results obtained, both a positive and a negative emotional expression were employed in the research to be described. An expression of happiness was chosen as the positive emotional expression and an expression of disgust as the negative emotional expression.

Disgust was chosen as the negative emotional expression because it is one of the universal 'basic emotions' for which facial actions, reliably related to specific emotional states, have been identified (Ekman, Friesen and Ancoli, 1980). Moreover, disgust displays are similar to smiling in that they involve both an upper and a lower face component. Disgust has the additional advantage that it can be reliably

[1] This is defined as time from the first visible facial movement to the apex of that movement.
[2] Defined as the time from the end of the apex of the expression until the expression is no longer visible.

and ethically elicited in a laboratory, for instance by using excerpts from educational television programmes on topics like surgery.

Based on the previously discussed findings, it was expected that spontaneous and deliberate expressions both of happiness and of disgust should differ regarding their speed of onset and offset. Further, some evidence suggests that spontaneous expressions might show fewer irregularities of the sort described by Weiss *et al.* (1987) than deliberate expressions. Two experiments were conducted to investigate the hypotheses at hand.

EXPERIMENT 1

Subjects were asked to pose expressions of happiness or disgust 'as well as possible' while spontaneous emotional facial expressions were elicited using an emotion induction procedure. The temporal parameters of interest: onset time, offset time, and time at apex, as well as the irregularities (pauses and stepwise intensity changes) within the expressions were measured and compared between conditions. It was felt to be important that the expressive episodes analysed were actual examples of spontaneous and deliberate facial expressions respectively. Therefore, self-reports regarding the emotional state of the subject during the trial were obtained from the stimulus persons and were used as a selection tool. That is, only episodes during which the stimulus persons reported to have felt the relevant emotion during the spontaneous condition were retained as spontaneous episodes; conversely, only episodes during which the subject reported not to have felt any emotion more than slightly were retained as deliberate episodes. This is important for two reasons, firstly, a common problem in emotion research is that not all subjects react in the same manner to an emotion elicitor. Therefore, even when a large majority of subjects finds, for example, a given stimulus highly amusing, some might find it not at all funny, or it might even remind them of a personal problem and induce negative affect. The same might be true for elicitors of negative affect. The surgery videos, for example, tend to elicit high levels of disgust (Kappas, 1989), but some subjects are interested in surgery techniques and therefore tend to report feelings of interest rather than of disgust. Secondly, the literature on the facial feedback hypothesis (e.g. Manstead, 1988), suggests that subjects may feel some emotion during posing.

Method

Subjects

Twenty male and 20 female undergraduates participated individually either for extra course credit or for $5. Data from one subject were later excluded because she was chewing gum during the experiment and from an additional four subjects because of instrument failure, leaving 17 female and 18 male subjects.

Tasks

Facial expressions were elicited during two different types of elicitation conditions (spontaneous and posed) and for two different emotions (happiness and disgust). The spontaneous expressions were elicited by inducing the relevant emotional state.

Two elicitation procedures were employed for all subjects, a video elicitation and an imagery procedure. For the first procedure, subjects watched an emotionally evocative video episode. For the second procedure, subjects were asked to relive an emotional experience. To elicit the posed expressions, subjects were asked to pose the expression as well as possible while not attempting to feel the emotion relevant to the expression. To justify the procedure, subjects were told that facial expressions may influence the physiological measures taken (see below); the pose condition was presented as a control condition. Subjects were allowed as many trials as they wished up to a limit of three minutes. They were instructed to press a button when they felt that the last pose was adequate. During all tasks subjects were instructed to look at the video monitor. All subjects were unobtrusively video-taped during the tasks. The tasks were counterbalanced between subjects. Following the completion of the tasks subjects were fully debriefed and permission to use the video record was obtained.

Episode selection and scoring procedure

Immediately following each task subjects filled out a self-report form regarding the difficulty of the task (7-point scale) and the intensity with which they felt each of the following emotions during the task: peacefulness, fear, anger, happiness, interest, sadness, and disgust (5-point scales).[3]Only expressive episodes that were elicited during one of the 'spontaneous' conditions for which the subject reported a rating of 3 or more on the target scale and a rating of not more than 1 on any of the other emotion scales were retained as spontaneous expressions. Likewise, expressive episodes that were elicited during the posing task for which the subject reported a rating of not more than 1 on any of the scales were retained as deliberate expressions. All other expressive episodes were excluded from further analysis. Ratings on the scale 'interest' were not considered for this selection.

For each subject only one episode per condition was selected. Given that the self-report criteria were fulfilled, the last expression performed by the subjects was analysed for the spontaneous expression from the imagery condition and the posed expressions. For the video episodes the last episode could frequently not be analysed as the expressive behaviour continued until after the end of stimulus presentation and therewith the end of the recording period. Therefore, for the video episodes the first expression was analysed. The selection process resulted in a set of 140 episodes.

Time scores

Onset time, offset time and time at apex were measured for each expressive episode.[4] An expressive episode was defined as follows: from the first visible change from a neutral face or a background expression (a background expression is an expression

[3] In Experiment 1 only, heart rate, skin conductance, and skin temperature were also measured; the sensors were attached to the subjects' left hand. Half the subjects employed a continuous self-report measure as well as the retrospective self-report. Results regarding these additional measures will not be discussed in this context.

[4] The expressive episodes were identified using the FACS (Ekman and Friesen, 1978) scoring procedures. In addition to the time scores, complete FACS scores were obtained, but will not be discussed in this context.

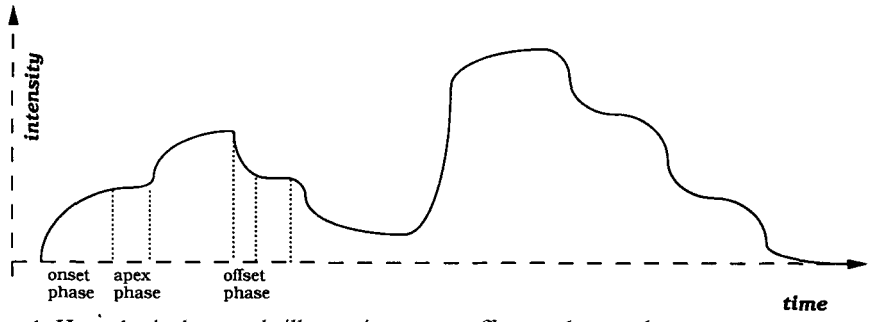

Figure 1. Hypothetical example illustrating onset, offset, and apex phases

held for extended periods of time, while other action units come and go) back to a neutral facial expression or to the background expression. An expression was also considered to be ended when subjects started oral/facial manipulations or when they yawned and/or looked away. Onset time was defined as the time from the start of the expressive episode to a peak of intensity. Time at apex was the amount of time the expression is held at the peak and offset time was the time from the first evidence of fading of the expression until it stopped fading. Therefore, if the expression did not return to neutral after a peak, but went through a sequence of fading and intensifying, it might have several onset, offset, and apex times. Namely, if an expression showed disruption or pauses in the onset or offset each step was counted as a separate onset or offset phase, the pause as an apex phase. Also, several onset and offset phases might follow each other directly if the expression was never held for longer than the resolution of the counter employed (1/10th of a second). If more than one onset and offset time, and time at apex occurred, these times were averaged for each expression. That is, the onset and offset times, and the times at apex, employed in the analyses, refer to the average duration of onsets, offsets, and apexes for each expression. The degree of irregularity of the expression is defined by the number of onset, offset, and apex phases the expression contains. Figure 1 illustrates these parameters.

Reliability was assessed on a subset of 20 randomly chosen episodes. A second rater established the number of phases within an episode and measured the length of each individual phase. Reliability for the number of onset, offset, and apex phases, that is, irregularities ($r = 0.88$); as well as for length of the phases, that is, onset and offset times, and times at apex ($r = 0.92$) was acceptably high.

Results

Manipulation check

The spontaneous emotional expressions, were elicited by inducing an emotional state using either an emotionally evocative video episode or an imagery procedure. In contrast, subjects were not supposed to feel an emotion during the pose condition. Table 1 shows the means and standard deviations as a function of emotion and elicitation condition based on all subjects. The ratings for the two spontaneous conditions were averaged.

The data show that the manipulation was successful. Subjects reported having

Table 1. Means for self-reported emotional state by emotion condition and elicitation condition

	Spontaneous		Deliberate	
Emotional state	Happy	Disgust	Happy	Disgust
Happiness	2.86 (0.58)	0.23 (0.52)	1.04 (0.68)	0.43 (0.82)
Disgust	0.05 (0.12)	2.87 (0.79)	0.07 (0.28)	1.20 (1.1)

Note: The standard deviations are given in parentheses.

felt the target emotion during the spontaneous conditions. As expected, they also felt some emotion during the deliberate (pose) condition, but on a considerably lower level.

Multiple regression analyses

As mentioned above, the expressive episodes were selected based on the self-report data to ensure that only expressive episodes during which the subject actually felt the relevant emotion were analysed as emotion elicited expressions and only those where the subject did not feel an emotion were analysed as deliberate. Therefore, not all subjects contributed expressions to all conditions. Since this could cause a dependency problem in the following analysis, subject variance was first removed using a multiple regression analysis with dummy coded subject indicator variables as predictors and onset and offset time, and time at apex respectively as the criterion. The same procedure was performed for the irregularities (number of phases). All following analyses are based on the residuals.

In addition, this selection resulted in unequal cell sizes. Therefore, a multiple regression approach was employed with emotion (happy, disgust), condition (emotion elicited, posed) and the interaction term as predictors and onset and offset time, and time at apex as the criterion. The results of this analysis are comparable to the results of a univariate 2×2 ANOVA (Cohen and Cohen, 1983).

Time data

The analysis of the time data showed no main effects or interactions for average onset and offset time or average time at apex. An analysis of the total length of the expression revealed a main effect for condition, with posed expressions being longer than emotion elicited expressions (*beta*: -0.24; $p < 0.05$). The average phase length over all conditions was (in 10th of seconds) $M = 20.44$ ($S.D. = 32.27$, $Md = 13.14$).

Irregularity

The analysis of the irregularities (number of phases) of the expression showed a main effect for condition for all frequency of phases measures (onset, offset, and apex; multiple R's: 0.43, $p < 0.05$, 0.35, $p < 0.05$, and 0.35 $p < 0.01$ respectively). The direction was the same for all types of phases; posed expressions had more onset, offset, and apex phases. A main effect for emotion emerged for onset and apex phases, with disgust expressions having more onset and apex phases. A marginal interaction was found for onset phases only. Table 2 shows the beta values and

significance levels for the phase variables and the mean residuals as a function of emotion and elicitation condition.

Table 2. (a) Mean residuals for irregularities as a function of emotion and elicitation condition. (b) Beta values for number of phases as a function of elicitation condition and emotion

(a)	Spontaneous		Deliberate	
Irregularities	Happy	Disgust	Happy	Disgust
Onset	−0.23 (0.51)	−0.06 (0.74)	0.02 (0.69)	0.86 (1.4)
Offset	−0.18 (0.63)	−0.27 (0.62)	0.20 (0.91)	0.61 (1.2)
Apex	−0.21 (0.58)	−0.15 (0.70)	0.11 (0.80)	0.73 (1.3)
Total	−0.22 (0.57) (1.3)	−0.15 (0.70)	0.10 (0.77)	0.80 (1.3)
(b)				
Variable	Onset	Offset	Apex	Total
Condition	−0.33*	−0.36*	−0.35*	−0.36*
Emotion	−0.28†	n.s.	−0.19‡	−0.21‡
Interaction	0.19‡	n.s.	n.s.	n.s.

*$p < 0.01$.
†$p < 0.05$.
‡$p < 0.1$.

Although a significant main effect for condition emerged for the length of the expression, replicating findings by Ekman and Friesen (1982), this cannot be interpreted as indicating differences between posed and spontaneous expressions in the time domain as such. Rather, it is more accurate to see this difference as an artifact of the underlying difference in the number of phases across the conditions. The data are consistent with the view that posed expressions are longer than spontaneous expressions because there are more phases in posed than in spontaneous expressions. A trend emerged suggesting that this effect was more marked for the disgust expressions.

Discussion

The results indicate that posed and spontaneous expressions differ in the time domain insofar as posed expressions are longer and have more phases. No specific differences regarding onset or offset, as suggested by Ekman and Friesen (1982) were found. The predictions by Ekman and Friesen regarding overall length were confirmed, but the data contradict the notion that posed expressions have shorter onsets.

In summary, while the spontaneous, emotion elicited, and deliberate, posed, emotional expressions of happiness and disgust differed significantly regarding the number of irregularities, a difference regarding the time domain was found only for the total length of the expression. However, the latter effect seemed to be driven by a difference in the number of phases. Deliberate expressions contained more phases, that is, more pauses and stepwise intensity changes, than did spontaneous expressions. This finding is consistent with the view that subjects produced the posed expressions by gradually approximating a desired pose. Since subjects were only

asked to pose as well as possible and not explicitly to deceive an observer they may have taken less care with the temporal aspects of the expression. While this provides a plausible explanation for the results found in Experiment 1, there is some doubt that these results can be generalized to deceptive expressions in general. Given the number of simultaneous demands on a person engaged in social deception a closed control loop as tightly modulated as the results of this study suggest is unlikely. However, spontaneous expressions are generally considered to be more smooth, reflex-like, and ballistic than voluntary expressions (see Rinn, 1984); thus voluntary expressions used in social deception should also be more irregular than spontaneous expressions, but less irregular than the posed expressions elicited in Experiment 1.

The findings reported above do not confirm earlier findings by Ekman and Friesen (1982) regarding onset and offset times and times at apex, and only partially the findings of Weiss *et al.* (1987). Hence, it is useful to investigate the specific differences between the present research and the studies of these other investigators. Ekman and Friesen (1982) elicited voluntary smiles by asking subjects to mask their negative emotional state with a positive expression to deceive an interviewer present with them in the same room. Weiss *et al.* (1987) who likewise found significantly shorter onset times as well as more irregularities for posed than for spontaneous expressions, seated subjects before a one-way mirror and instructed them to convince an observer behind the mirror of the genuineness of the expression. It is possible that the discrepancies in findings regarding the differences between posed and spontaneous expressions are caused by these variations in the posing tasks. Namely, both Ekman and Friesen (1982) and Weiss *et al.* (1987) instructed their subjects explicitly to deceive an observer. In the present study, however, subjects were only asked to pose the expression as well as possible. On the other hand, both in Weiss *et al.*'s and in this study significantly more phases were found for voluntary expressions and in both cases the expressions were posed, while the subjects in Ekman and Friesen's study interacted with an interviewer during the deception task. As mentioned before, it is possible that subjects in this study carefully approached an ideal pose, thereby producing the larger number of phases. Subjects received no explicit instructions to deceive an observer and therefore may not have cared to produce a dynamically convincing expression, thereby obscuring some of the temporal differences found by Ekman and Friesen (1982). However, one can assume that differences in the number of phases will still be found between spontaneous and deliberate expressions, even if subjects explicitly attempt to deceive an observer, since these differences are an expression of the closed control loop nature of a deliberate expression.

EXPERIMENT 2

To investigate the hypothesis that the findings of Experiment 1, indicating that deliberate facial expressions differ from spontaneous facial expressions, in that they are more irregular, but not with respect to the length of onset and offset times, are *specific* to posed expressions, the general paradigm employed in Experiment 1 was replicated. Again, spontaneous and deliberate facial expressions of happiness and disgust were elicited. As before, the spontaneous and deliberate facial expressions of happiness and disgust were elicited from all subjects. As before in the video con-

dition, the spontaneous expressions were recorded while subjects watched humour- and disgust-provoking video segments under conditions where they presumed themselves to be alone and not under observation. However, in Experiment 2 the deliberate facial expressions were obtained while subjects watched the same video segments under explicit instructions to *deceive* others, who would view them on video-tape, about their emotional state. A cover story was employed to convince subjects that they were video-taped only during specific parts of the experiment.

The deliberate expressions were expected to differ from the spontaneous, emotion elicited, expressions in two ways (a) deliberate expressions should have shorter (average) onset and offset times and should be of longer duration; and (b) deliberate expressions should have more onset, offset, and total phases.

Method

Subjects

Twenty-three male and 25 female undergraduates participated individually in a 45 minute session. They were each paid $6.

Tasks

Subjects were informed at the outset that they would perform three different tasks and were given some information regarding each of the tasks. During the first task, they were to simply watch two brief videos on surgery and comedy. The general purpose of this task was to familiarize subjects with the kind of material they would be viewing. For the second task subjects were instructed to watch a different set of surgery and comedy videos while not attempting to inhibit their facial reactions since they would be video-taped. The intent of this instruction was to lead subjects to believe that the only difference between the first and the second task was the fact that they would be video-taped during the second task, but not the first. In fact, the spontaneous expressions of happiness and disgust were taken from the first task; expressions from the second task were not further analysed. For the third task subjects were told that they would again see happy and disgusting video segments, but this time they were instructed to deceive an observer about their actual emotional state by showing an emotional facial expression congruent not with the emotional state invoked by the video they were seeing but with the other video stimulus. Subjects were reminded that they would be filmed by a video camera hidden in the experimental setup. During this third task subjects saw the same video episodes they had seen during task 1.

Self-report measures

Following each task subjects completed a self-report form regarding the difficulty of the task (on a 7-point Likert scale) and the intensity with which they felt each of the following emotions during the task (on 5-point Likert scales: 0—not at all; 4—very intense): peacefulness, fear, anger, happiness, interest, sadness, and disgust.

They also rated on two 7-point scales how repulsive and how amusing each video episode was.

Stimuli

Two surgery and two comedy sequences were employed. The sequences were edited to be approximately 2:30 minutes in length. The episodes were selected from a larger pool of stimuli that had been rated for funniness and repulsiveness by subjects drawn from the same population as the sample used here. The episodes chosen were of approximately the same degree of funniness and repulsiveness respectively (see Kappas, 1989). All episodes were presented in colour and with the original sound track.

Procedure

Subjects, who participated individually, first read a consent form explaining (a) that they would be video-taped at various times during the experiment, (b) the nature of the deceptive task, and (c) that observers would later watch the video records and try to detect the deception. The form asked for permission to use the video records for this purpose. Subjects then watched one funny and one repulsive video. They were told that they would not be video-taped during this task, but that they should pay careful attention to the videos in preparation for the deception task. Following the completion of this first task, the experimenter reminded the subjects that they would be video-taped from then on.

The second and third tasks were counterbalanced between subjects. All subjects received detailed instructions before each task. The video stimuli were presented in an order counter-balanced between subjects. For subjects 19 through 48 this procedure was amended. Observations by the experimenter and the debriefing interviews suggested that subjects were initially quite nervous, because they did not know precisely what to expect and felt somewhat intimidated by the experimental set-up. To help subjects to relax before the experiment and to acquaint them with the experimental procedure a 2:00-minute nature film was shown, before the instructions for the first task were given. Subjects were told to just relax and to watch the film to 'settle down before the experiment'.

Following the experiment subjects were fully debriefed. Permission to use the video records from task 1 was obtained.

Results

Manipulation check

Table 3 shows the means and standard deviations as a function of emotion and condition for all subjects. The data show that subjects felt moderate happiness and disgust during the spontaneous happy and disgust conditions. Further, they felt moderately disgusted during the episodes during which they were asked to show deliberate expressions of happiness. However, the mean rating of happiness over all subjects for the condition where subjects were asked to show deliberate expressions of disgust are quite low.

Table 3. Means for self-reported emotional state by emotion condition and elicitation condition

	Spontaneous		Deliberate*	
Emotional state	Happy	Disgust	Happy	Disgust
Happiness	2.10 (1.0)	0.08 (0.35)	0.46 (0.74)	1.21 (1.3)
Disgust	0.08 (0.35)	2.46 (1.3)	1.90 (1.1)	0.46 (0.68)

* Note that subjects were supposed to employ a masking deception as the deliberate expression. That is, subjects who showed a happy facial expression felt disgust and *vice versa*.

Multiple regression analyses

Parallel to Experiment 1, the self-reports were employed to select episodes during which subjects felt the target emotions. For all subjects the first expression during each condition was analysed, if the self-report criterion was fulfilled, resulting in a set of 95 expressions. As again, different subjects contributed differing numbers of expressions, the two-step multiple regression procedure described for Experiment 1 was employed.

Time data

For all variables except average length of apex phases significant or marginally significant condition and emotion effects were found (onset: multiple R: 0.29, $p < 0.05$; offset: multiple R: 0.36, $p < 0.05$; total phase length: multiple R: 0.34, $p < 0.05$). Inspection of the beta weights showed that posed expressions had significantly shorter average onset, offset, and overall phase lengths and happy expressions had longer average onset, offset, and overall phase lengths. Table 4 shows the beta values for the four variables and the mean residuals as a function of emotion and elicitation condition. The average phase length over all conditions was (in 10th of seconds) $M = 13.10$ ($S.D. = 5.62$, $Md = 11.75$).

Table 4. (a) Mean residuals for phase length averages as a function of emotion and elicitation condition. (b) Beta values for phase length averages as a function of elicitation condition and emotion

(a)	Spontaneous		Deliberate	
Emotional state	Happy	Disgust	Happy	Disgust
Onset	0.54 (3.1)	0.28 (1.9)	0.21 (3.3)	−1.77 (2.1)
Offset	4.48 (11.6)	−2.04 (4.7)	1.39 (9.0)	−4.11 (6.2)
Apex	−0.08 (9.7)	0.58 (11.4)	0.78 (9.7)	−1.83 (6.8)
Total	1.38 (3.8)	−0.31 (3.7)	0.11 (3.9)	−2.50 (3.1)
(b)				
Variable	Onset	Offset	Apex	Total
Condition	0.21*	0.21†	n.s.	0.22†
Emotion	0.19*	0.24†	n.s.	0.28†
Interaction	n.s.	n.s.	n.s.	n.s.

* $p < 0.1$.
† $p < 0.05$.

Table 5. (a) Mean residuals for irregularities as a function of emotion and elicitation condition. (b) Beta values for number of phases as a function elicitation condition and emotion

(a)	Spontaneous		Deliberate	
Irregularities	Happy	Disgust	Happy	Disgust
Onset	−0.26 (1.1)	−0.49 (1.1)	1.02 (1.6)	−0.35 (1.2)
Offset	−0.15 (0.99)	−0.54 (0.88)	0.96 (1.3)	−0.40 (0.83)
Apex	−0.11 (1.4)	−0.81 (1.6)	1.37 (2.2)	−0.74 (1.3)
Total	−0.52 (3.2)	−1.83 (3.4)	3.35 (4.8)	−1.49 (3.0)
(b)				
Variable	Onset	Offset	Apex	Total
Condition	−0.25*	−0.27†	−0.21*	−0.25*
Emotion	0.28†	0.37‡	0.37‡	0.36†
Interaction	−0.20§	−0.21*	−0.19§	−0.21*

*$p < 0.05$.
†$p < 0.01$.
‡$p < 0.001$.
§$p < 0.1$.

A parallel analysis was conducted for the four phase variables. Table 5 shows the beta weights for the phase variables. (multiple R's: onset: 0.44, $p < 0.001$; offset: 0.50, $p < 0.001$; apex: 0.46, $p < 0.001$; total: 0.49, $p < 0.001$) and the mean residuals as a function of emotion and elicitation condition.

For all four variables a significant or marginally significant emotion and condition effect as well as an emotion × condition interaction emerged. Inspection of the beta weights revealed that posed expressions had more onset, offset, apex and total phases and that happy expressions had more onset, offset, apex and total phases than disgust expressions. These effects were modified by an emotion × condition interaction which suggests that while the trend was the same for disgust and happy expressions, a marked difference between posed and spontaneous expressions was found only for happy expressions.

Discussion

The results for the phase variables for the disgust expressions differ from the results of Experiment 1. In Experiment 1 the posed disgust expressions had the largest number of onset, offset, apex, and total phases, while in Experiment 2 the largest number of phases was found for the voluntary happy expressions. This difference may be due to the nature of the voluntary disgust expressions in the second experiment. In the first experiment, subjects were asked to pose the expressions while watching a neutral nature film. The choice of expression was left to them and they could concentrate on an ideal pose. In the second experiment, subjects were watching a comedy routine while attempting to deceive an observer that they were actually watching a surgery film. Further, subjects reported difficulty with this task in Experiment 2 and subjects' deliberate disgust expressions in Experiment 1 seemed to model on a vomiting reaction (mouth open, tongue show, etc.) which is highly incongruent with watching a comedy episode. These factors seem to combine to elicit a set of disgust expressions quite different from the ones elicited in Experiment 1.

GENERAL DISCUSSION

As expected the results regarding the dynamic parameters predicted to differ between spontaneous and deliberate expressions, onset time and offset time, were different for the two experiments. The results of Experiment 1 were not consistent with the hypotheses. Neither for the happy nor for the disgust expressions were significant differences in onset and offset time found between elicitation conditions. However, deliberate expressions showed more phases or irregularities (pauses and stepwise intensity changes) than spontaneous expressions, a difference suggested by Ekman and Friesen (1982) for which Weiss *et al.* (1987) reported some evidence.

Experiment 2 is in large part a replication of Experiment 1 and was conducted to investigate whether the failure in Experiment 1 to support Ekman and Friesen's (1982) notions that deliberate emotional facial expressions should have shorter onset and offset times was due to differences in the elicitation of the deliberate expressions between Experiment 1 and their experiment. Therefore, the deliberate expressions in Experiment 2 were elicited by asking subjects to deceive an observer about their emotional state by masking it with an incongruent emotional expression.

Regarding onset and offset times, the results are consistent with the view that differences in onset and offset time should be evident when subjects are explicitly asked to deceive an observer. Regarding the number of irregularities the same main effect for condition was found as in Experiment 1; deliberate expressions were characterized by more onset, offset, apex, and total phases.

In Experiment 2, but not in Experiment 1, an emotion × condition interaction was found; deliberate happy expressions had a larger number of phases than spontaneous happy expressions, but the opposite was the case for the disgust expressions. Because subjects had to mask an underlying positive affect in Experiment 2, but were quite free in choosing an expression in Experiment 1, one might argue that the deliberate disgust expressions might differ for the two experiments. FACS scores obtained in Experiment 1, suggest that subjects were posing a type of disgust associated with vomiting (e.g. mouth open, tongue show), this type of expression was probably incongruent with watching a comedy film. In addition, there is evidence that a wider range of disgust expressions than of happy expressions exists (Wiggers, 1982). If this is the case, subjects might have chosen a different disgust display as more appropriate for masking in Experiment 2 than the one chosen for posing in Experiment 1.

In summary, Experiment 2 provided evidence in support of the notion that onset and offset times differ between elicitation conditions. Offset times were significantly shorter for deliberate than for spontaneous expressions, for onset times the effect was marginally significant.

Moreover, spontaneous and deliberate happy facial expressions differed in the number of phases; this finding replicated the findings from Experiment 1. In Experiment 2, but not in Experiment 1, an emotion × condition interaction was found for the number of phases. This may be related to the nature of the deceptive disgust expressions chosen by the subjects in the two experiments.

In comparing the results from Experiments 1 and 2 regarding the nature of the facial behaviours displayed, both similarities and differences are present. For the happy expressions the findings regarding the differences between spontaneous and deliberate facial expressions in the number of phases from Experiment 1 were repli-

cated in Experiment 2. For the disgust expressions, on the other hand, the findings differed between Experiments 1 and 2. Namely, only in Experiment 1 were deliberate disgust expressions characterized by a marked increase in the number of phases compared to the spontaneous expressions. As noted earlier, this might be, because subjects in Experiment 1 chose to display a different type of disgust expression (vomiting) than those in Experiment 2. While there are different facial expressions of disgust, there is only one expression, the smile, of happiness, allowing for less choice on the part of the subjects.

Why do spontaneous and deliberate facial expressions differ regarding irregularities or phases? Spontaneous and deliberate facial expressions are mediated by different neurological pathways and spontaneous emotion elicited expressions are believed to be generally more reflex-like, smooth and ballistic than deliberate expressions (see Rinn, 1984). Furthermore, it seems plausible that subjects who are asked to pose an expression have a specific view of an appropriate expression for that pose. In attempting to show that expression they are likely to use a closed-control loop approach, which disrupts the smooth dynamics of the expression. This type of control is likely to result in a 'ratcheting' of the expression.

It is interesting to note that the deliberate facial expressions of happiness were characterized by more irregularities in both Experiment 1 and Experiment 2. This, given the differences between the two experiments regarding the deliberate expressions, shows the finding to be relatively stable. For the first study one might argue that the subjects did not feel observed and therefore only concentrated on what the expression would look like at its apex, without attempting to make the overall expression convincing. In the second experiment, however, subjects were aware that they were video-taped and that at a later time observers would attempt to detect when they were showing the spontaneous expression and when they were showing a deceptive expression.

Following this argument fewer differences in aspects of the time course between spontaneous and deliberate facial expressions should have been found on Experiment 2. On the other hand the subject's task in Experiment 2 was somewhat more difficult than in Experiment 1. Subjects were asked to display an emotional facial expression incongruent to the emotional state elicited by watching a video stimulus at the same time. The complexity of the situation, that is, the necessity to not display the emotion elicited by the video stimulus, while at the same time displaying an incongruent emotional facial expression, might have resulted in subjects neglecting to attempt to control the time course aspects of the expression. However, it is one of the characteristics of deceptive interactions that the deceiver is confronted with a complex situation and one can argue that the findings from this experiment are nevertheless generalizable to social situations outside the laboratory.

It is noteworthy, that the differences between spontaneous and deliberate facial expressions were found for both a negative and a positive emotional expression.[5] This allows the conclusion that the differences in the dynamics of spontaneous and deliberate facial expressions may generalize over emotions and are due to voluntary nature of the expressions more than the valence of the emotions expressed. However, comparing the findings from Experiments 1 and 2 suggests that the dimensions in

[5] While the difference in phases was not significant for the disgust expressions in the second experiment the means were in the same direction.

which the expressions differ as well as the degree of the difference may be moderated by the intent of the deliberate expression (intended to represent a good pose or to deceive) and the emotion expressed.

In summary, the present research provides strong evidence for the notion that the irregularity of the expression differentiates spontaneous and deliberate happy expressions and tentative evidence for this difference in disgust expressions, while addressing some of the methodological concerns regarding previous research. Further, the diverging results concerning onset and offset times between the two studies emphasize the importance of distinctions between different realizations of the construct 'deliberate expression'. The results indicate that poses and 'masking deceptions', while sharing some characteristics, differ in their onset and offset times. Ekman and Friesen (1982) proposed a frame of reference regarding different types of deliberate smiles. The results reported here point to the necessity to extend this frame of reference to other emotional displays to guide future research interested in differences between spontaneous and deliberate facial expressions.

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