Behavioral Markers and Recognizability of the Smile of Enjoyment

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Ekman and Friesen (1982) predicted that smiles that express enjoyment would be marked by smoother zygomatic major actions of more consistent duration than the zygomatic major actions of nonenjoyment smiles. Study 1 measured the duration and smoothness of smiles shown by female subjects in response to positive emotion films while alone and in a social interaction. Enjoyment smiles in both situations were of more consistent duration and smoother than nonenjoyment smiles. In Study 2 observers who were shown videotapes of enjoyment and nonenjoyment smiles were able to accurately identify enjoyment smiles at rates greater than chance; moreover, accuracy was positively related to increased salience of orbicularis oculi action. In Study 3, another group of observers were asked to record their impressions of the smiling women shown in Study 2. These women were seen as more positive when they showed enjoyment compared with nonenjoyment smiles. These results provide further evidence that enjoyment smiles are entities distinct from smiles in general.

The facial expression commonly referred to as "the smile" in fact is not a singular category of facial behavior. As far back as 1862 the French anatomist G. B. Duchenne (1862/1990) noted that the orbicularis oculi muscle, which surrounds the eye, is recruited in smiles that occur with spontaneously experienced enjoyment but not in smiles that are posed (Duchenne, 1862/1990). However, only in the last 10 years have researchers gathered the empirical evidence to confirm Duchenne's observation (Ekman & Friesen, 1982). This particular configuration of the enjoyment smile[1] identified by Duchenne—the orbicularis oculi with zygomatic major—has been called the *Duchenne smile* in honor of Duchenne's original observation (Ekman, 1989).

On the basis of Duchenne's (1862/1990) observation as well as their own empirical observations of a large data set (Ekman, Friesen, & Ancoli, 1980), Ekman and Friesen (1982) predicted that the Duchenne smile would be but one among several morphological and temporal markers of the enjoyment smile. Specifically, they predicted that an enjoyment smile would be marked by (a) The presence of orbicularis oculi, pars lateralis, in conjunction with zygomatic major[2] (Duchenne's smile); (b) synchronization of action between the zygomatic major and orbicularis oculi such that they reach the point of maximal contraction (apex) at the same time; (c) symmetrical changes in zygomatic major action on both sides of the face; (d) onset, apex, offset, and overall zygomatic major actions that are smooth and not as long or short as in other types of smiles; and (e) a duration range of zygomatic major action between 0.5 and 4 s.

Research findings have confirmed the existence of four of these five predicted enjoyment smile markers (the synchrony marker has yet to be systematically explored). The most replicated and best documented of these markers, which has shown the most convergent validity across subject groups and social conditions, is Duchenne's marker—the presence of orbicularis oculi activity. A number of studies have confirmed the presence of this marker in smiles that occur in situations designed to elicit positive emotions compared with in situations designed to elicit negative emotions—even though there was no difference

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This research was supported by National Institute of Mental Health National Research Service Award MH09827 to Mark G. Frank and a Research Scientist Award (MH06092) to Paul Ekman.

We thank Erika Rosenberg for her assistance and David Matsumoto and the original reviewers of this article for their comments.

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[1] Enjoyment smiles were originally called *felt smiles*, and nonenjoyment smiles were originally called *unfelt smiles* in the Ekman and Friesen (1982) article. Now, given the large amount of evidence across different measures that links smiles with the orbicularis oculi, zygomatic major configuration to positive emotion (reviewed later in this article), we use the term *enjoyment smile* to describe a smile with that particular configuration.

[2] On the basis of their observations and their findings that most people can voluntarily produce the action of the inner but not the outer part of the orbicularis oculi muscle (Hager & Ekman, 1985), Ekman and Friesen (1982) differed from Duchenne (1862/1990) in specifying that it is only the outer portion of this muscle that distinguishes enjoyment.

Journal of Personality and Social Psychology, 1993, Vol. 64, No. 1, 83-93

between these situations in the total amount of smiling when smiles were considered as a group without regard for Duchenne's marker (e.g., Davidson, Ekman, Saron, Senulius, & Friesen, 1990; Ekman, Davidson, & Friesen, 1990; Ekman, Friesen, & O'Sullivan, 1988). Similar results have been reported for 10-month-old infants (Fox & Davidson, 1988), children (Schneider, 1987), and German adults (Ruch, 1987). In psychotherapy settings, the Duchenne-marked smiles occurred more often in depressed patients' discharge interviews compared with in their admission interviews (Matsumoto, 1986). Moreover, the number of smiles featuring the Duchenne marker increased when psychotherapy patients were judged to improve (Steiner, 1986).

Smiles with the Duchenne marker have been linked to the emotion of enjoyment not only across a variety of settings but also across a variety of measures. When subjects show smiles with the Duchenne marker, compared with other types of smiles, they (a) report more felt enjoyment (Ekman et al., 1990) and (b) display a different pattern of central nervous system (CNS) activity (Davidson et al., 1990; Ekman et al., 1990). Furthermore, the degree to which the CNS patterns differ between Duchenne-marked smiles and other smiles is significantly correlated with the subject's self-reported enjoyment.

Compared with the amount of research on Duchenne's marker, there have been only a few studies on the symmetry and on the smoothness of onset markers of enjoyment (e.g., Ekman, Hager, & Friesen, 1981; Weiss, Blum, & Gleberman, 1987), and only one study confirmed Ekman and Friesen's (1982) prediction that enjoyment smiles typically last between 0.5 to 4 s, with nonenjoyment smiles either shorter or longer. This duration marker distinguished smiles that spontaneously occur in response to comedy films from smiles that had been deliberately posed (Hess & Kleck, 1990).

Study 1

No prior study has yet examined more than one of the markers that differentiate enjoyment from other types of smiling. The first part of our strategy was to select a sample of smiles on the basis of the best substantiated marker of enjoyment (Duchenne's) and then determine whether such smiles also showed the limited duration marker. The duration marker was selected because it is reliably measured and conceptually straightforward. It involves merely recording the point at which a subject's zygomatic major begins to move from its neutral position and the point at which it returns to neutral. Such ease of measurement is not the case for some of the other enjoyment smile markers; for example, the symmetry marker may be extremely subtle and difficult to measure (see Ekman et al., 1981, for details).

The second part of our strategy was to examine the smoothness of the smiles with Duchenne's marker versus other smiles by measuring the duration relationships among the components of these smiles. Smooth smiles should show a significant positive correlation among the onset, apex, offset, and overall zygomatic major durations; smiles that are not smooth should not show such a pattern. This method is in contrast with facial electromyography (EMG) research, which measured the smoothness of a smile by recording the number of onset and offset periods before a smile returned to a neutral expression (Hess & Kleck, 1990). However, this smoothness criterion assumes that the onset and offset periods were not actually separate smiles or distinctive facial behaviors when in fact they could have been. Our measure of facial behavior did not assume a return to neutral as the end of a given smile and thus eliminated this potential confound.

Our first hypothesis was that smiles with the Duchenne marker will be more consistent, or less variable, in their overall duration than smiles without this marker. This prediction had two sources. First, it is consistent with Ekman and Friesen's (1982) empirical observation that emotional expressions have a more limited duration than do nonemotional expressions, the former usually between 0.5 and 4 s in length, while the latter varies from 0.25 s to considerably longer than 4 s. The second basis for the hypothesis about a more limited duration for emotional compared with nonemotional expressions was Ekman's (1992) theory that emotions are brief, episodic events that last only a few seconds. There is no such constraint on volitional or nonemotional expressions.

Our second hypothesis was that smiles with the Duchenne marker should be smoother and more ballistic than other smiles. This hypothesis was based on evidence of distinct neural substrates for emotional and nonemotional facial activity. It appears that not only do emotional and nonemotional facial activity originate from different areas of the brain (subcortical and cortical motor strip, respectively) and arrive at the face through different motor systems (extrapyramidal and pyramidal, respectively), but also the appearances of these actions differ such that extrapyramidally driven emotional facial actions are smoother and more ballisticlike than pyramidally driven nonemotional facial actions (DeMyer, 1980; Meihlke, 1973; Myers, 1976; Tschiassny, 1953; also see review by Rinn, 1984). Thus, emotional facial actions should manifest this smooth, ballisticlike pattern by showing internal consistency among the components of the zygomatic major action such that there will be a positive relationship among the onset, apex, offset, and overall durations of each Duchenne-marked smile. There should be no such coordination among the components of smiles without the Duchenne marker.

Method

Materials. Both the smiles with Duchenne's marker and the smiles that did not evidence Duchenne's marker were drawn from two prior experiments in which subjects' facial behavior was recorded without their knowledge while they watched films designed to elicit emotional responses. These films were shown in the same order in both experiments; the difference was that in one experiment the subjects watched the films alone while their brain activity was measured (quite obtrusively; Davidson et al., 1990), and in the other experiment they described their feelings to an interviewer (Ekman & Friesen, 1974). These two situations are referred to as the *solitary* and *social interaction* situations, respectively. In the solitary situation, the subjects were told that they would be watching the film in private in a darkened room. The only light in this room was the ambient light from the film and a dim red light, which enabled subjects to see and properly use a rating dial. In the social interaction situation, the interviewer sat facing the subject such that the interviewer could not see the film. In both situations the number of smiles with the Duchenne marker correlated significantly with each subject's self-report of enjoyment; in each situation there was no relationship between the total number of all types of smiles and each subject's self-report of enjoyment (Ekman et al., 1990; Ekman et al., 1988).

Both samples of these smiles had been scored previously using the Facial Action Coding System (FACS; Ekman & Friesen, 1978). FACS allows for the measurement of all visible facial behavior and not just actions presumed to be relevant to emotion. FACS scores movement, intensity, and laterality of the facial muscle action. FACS allows for but does not require determining the duration of an action. Facial actions that were FACS scored for both zygomatic major (FACS Action Unit 12) and orbicularis oculi, pars lateralis (FACS Action Unit 6) composed the sample of smiles with the Duchenne marker; facial actions that consisted of FACS-scored zygomatic major (Action Unit 12) without orbicularis oculi composed the sample of smiles without the Duchenne marker. For the purpose of this study, all other facial actions were not considered.

Procedure. For each subject, one smile with the Duchenne marker and one smile without the marker were randomly selected from the first three of each type of smile shown during the course of viewing the films designed to elicit a positive emotion.[3]

This was done to increase the likelihood that the most spontaneous Duchenne-marked smiles would be chosen, as well as to ensure a comparable sample of smiles without the marker. If a subject failed to show at least one smile with and one smile without the Duchenne marker, they were dropped from further analysis. This left a total of 44 subjects who contributed exactly one Duchenne-marked smile and one smile without the Duchenne marker each; 22 subjects were from the social interaction situation, and 22 subjects were from the solitary situation.

Mark G. Frank scored each of the selected smiles for duration. Because he knew the hypothesis, allowing for the possibility that his duration scoring might be biased, one third of this sample was later scored by a FACS-trained scorer who did not know the hypothesis (Erika Rosenberg). The measurements of the two scorers were highly correlated (Pearson $r = +.86$).

Design and variables. The analysis examined the effect of the type of smile (with Duchenne marker vs. without Duchenne marker) and the situation from which the smiles were drawn (social interaction vs. solitary) on the duration and smoothness of the smiles. The type of smile was a within-subject variable. The hypothesis predicted that the durations of the smiles containing Duchenne's marker will cluster to a greater extent about a mean duration and thus will be less variable than the durations of smiles that do not have Duchenne's marker. This was expected regardless of whether the smiles were shown in the social interaction or solitary situation. Likewise, smiles with the Duchenne marker would be smoother than smiles without; this smoothness would be manifested by a significant correlation among the onset, apex, offset, and overall duration of the smile.

These hypotheses make no prediction about whether there will be a difference in the mean duration of the smiles with Duchenne's marker versus those without; it makes a prediction only about the variance and smoothness of smiles with Duchenne's marker versus smiles without the Duchenne's marker.

Results

Overall analyses. Table 1 shows the means and variances for the duration of smiles with and without Duchenne's marker in both the social interaction and solitary situation.

A test for the equality of variances (Brown & Forsythe, 1974) showed that, as predicted, the variance associated with the duration of smiles with Duchenne's marker was significantly less than the variance associated with the duration of smiles without Duchenne's marker, $F(1, 31) = 8.11$, $p < .005$.[4] This result

Table 1
Overall Duration of Smiles by Situation (in Seconds)

Type of smile	Situation: Social interaction	Solitary	Pooled
With Duchenne marker			
M	3.32	6.18	4.75
Variance	2.04	34.65	20.01
Without Duchenne marker			
M	4.14	10.04	7.09
Variance	7.56	165.53	93.43
N	22	22	44

was obtained in both the social interaction situation, $F(1, 14) = 4.69$, $p < .05$, and the solitary situation, $F(1, 15) = 9.76$, $p < .01$.[5]

This inequality of variances led us to apply a nonparametric Wilcoxon matched-pairs signed-ranks test to the mean duration of the smiles. This test revealed no significant difference between the mean duration of smiles with Duchenne's marker versus smiles without ($Z = -1.02$, *ns*). There was also no significant difference in the mean duration of smiles in the solitary ($Z = -.78$) or the social interaction conditions ($Z = -.94$). A Mann-Whitney test on the overall duration of both types of smiles in the solitary condition versus both types of smiles in the social interaction condition also showed no significant effect of situation on duration of the smile ($Z = -1.74$, $p < .09$).

It should also be noted that the mean duration of the Du-

[3] Researchers have reported a ratio of seven enjoyment smiles to one nonenjoyment smile in positive emotion situations (Ekman et al., 1990; Ekman et al., 1988). There are a variety of reasons why a nonenjoyment smile would occur in a positive emotion situation: (a) because subjects knew that they would be viewing gruesome films after the positive emotion films, (b) because subjects were displaying or expressing uncertainty, and (c) to maintain the conversational flow. It may seem more unusual that subjects would show nonenjoyment smiles in the solitary situation; however, subjects do show smiles when they anticipate that something enjoyable may be upcoming on a film but before they experience that emotion (Ekman, 1985, has called these *anticipatory* smiles). In addition, they can imagine the presence of someone, which may cause subjects to show social nonenjoyment smiles (e.g., Fridlund, 1991).

[4] All p values reported in this article are two-tailed.

[5] Across both situations, this sample contained smiles with the Duchenne marker that were of greater zygomatic intensity than were smiles without it (as scored by FACS intensity ratings ranging from A (*very slight intensity*) to E (*strongest possible intensity*). After we converted these A through E ratings to 5-point ratings, the smiles with the Duchenne marker appeared to be of greater intensity ($M = 3.07$, $SD = 1.17$) than smiles without the Duchenne marker ($M = 1.77$, $SD = .74$), $F(1, 42) = 58.71$, $p < .001$. These zygomatic intensity differences show that the smiles with the Duchenne marker were also more variable in zygomatic intensity than other smiles; this works against the hypothesis that smiles with the Duchenne marker will be less variable in duration than smiles without. The intensity of the zygomatic major action also did not covary either with the duration of the Duchenne-marked smiles ($\beta = .09$), $t(21) = 0.59$, *ns*, or the duration of other smiles ($\beta = -.16$), $t(21) = -1.03$, *ns*.

chenne smiles in the social interaction situation was between 0.5 and 4 s, as originally predicted by Ekman and Friesen (1982). However, the mean duration of smiles with the Duchenne marker in the solitary situation were considerably longer at 6.18 s, even though these smiles were, as predicted, significantly less variable than the smiles without Duchenne's marker. This finding is considered in more detail later.

Component analyses. It may be the case that the difference in variability between smiles with Duchenne's marker and smiles without Duchenne's marker is due entirely to a difference in the variability of either the onset, apex, or offset duration (e.g., Bugental, 1986). Thus, the overall duration of a zygomatic major action was broken into its three constituents: the onset duration (duration from beginning of action until apex), apex duration (duration from beginning of apex until end of apex), and offset duration (duration from end of apex until the return to neutral). There was strong intercoder reliability in the measurement of the components (all Pearson *r*s > +.78). The statistical tests for equality of variances and mean duration differences applied to the overall durations just discussed were repeated for each of the three components of the smile.

As was the case in the overall smile duration analysis, the onset duration of smiles with Duchenne's marker had considerably less variance (variance = 1.16) than the onset duration of smiles without this marker (variance = 6.63), $F(1, 29) = 8.49$, $p < .007$; this pattern occurred within both the social interaction situation, $F(1, 14) = 8.98$, $p < .02$, and the solitary situation, $F(1, 14) = 4.78$, $p < .05$. There was no significant overall effect for onset duration as well as no significant effect for onset duration within either situation (all *Z*s < 0.72, *ns*).[6]

A similar pattern of variances occurred for the apex duration; the apex durations for smiles with Duchenne's marker had less variance (variance = 5.36) than did the apex durations of the smiles without Duchenne's marker (variance = 74.13), $F(1, 29) = 8.13$, $p < .009$. This applied marginally to the social interaction situation, $F(1, 13) = 3.48$, $p < .08$, and significantly to the solitary situation, $F(1, 14) = 10.74$, $p < .007$. The mean apex durations did not differ taken together or separated by situation (Wilcoxon *Z*s < 1.11 and < 1.12, respectively).

Contrary to what might be expected, the offset durations of the smiles with Duchenne's marker were not less variable than the offset durations of the smiles without Duchenne's marker, $F(1, 28) = .90$, *ns*. Whereas there were no differences in variance of the mean offset durations in the solitary situation, $F(1, 13) = 0.02$, *ns*, there was a significant difference in variance for the social interaction situation, $F(1, 14) = 11.44$, $p < .005$, where the offsets of smiles with Duchenne's marker were less variable. There was no significant effect for mean overall offset duration (Wilcoxon $Z = 0.12$, *ns*) or for offset duration within each situation (Wilcoxon *Z*s < 0.89, *ns*).

Our second hypothesis was that smiles with the Duchenne marker are extrapyramidally driven facial actions—that is, consistent, ballistic, and more reflexlike—thus, they also should show a more stable relationship among their smile components than should smiles without the Duchenne marker. One way to measure the stability of this relationship is to examine the intercorrelations among the onsets, apexes, offsets, and overall durations of the different smiles. If smiles with the Duchenne marker are more consistent and smooth in their actions, then within these smiles the components should be significantly correlated with each other.

This was the case with Duchenne-marked smiles, where the overall durations of these smiles correlated significantly with their onset durations (Pearson $r = +.81$, $p < .001$), apex durations (Pearson $r = +.52$, $p < .001$), and offset durations (Pearson $r = +.67$, $p < .001$). Moreover, there was a significant correlation between the smiles' onset durations and their offset durations (Pearson $r = +.47$, $p < .01$). This pattern held in both the social interaction situation and the solitary situation. In contrast, there was only one significant correlation between or among the components of smiles without Duchenne's marker and that was between the overall durations and their apex durations (Pearson $r = +.94$, $p < .001$). This pattern of results strongly suggests that smiles with the Duchenne marker function as a relatively stable unit of behavior; that is, smiles with longer durations have longer onsets, apexes, and offsets, and vice versa. Such was not the case for smiles without Duchenne's marker; for these smiles the overall duration was solely dependent on the duration of the smile's apex.

Discussion

These results are consistent with the proposal that smiles with the Duchenne marker act more like emotional facial actions, as predicted. Smiles with Duchenne's marker manifest significantly less variability than smiles without Duchenne's marker in both overall duration and the duration of their onsets and apexes. Moreover, Duchenne-marked smiles display a regularity and smoothness of action such that the length of any given smile is proportionally spread about its onset, apex, and offset. In contrast, a smile without the Duchenne marker shows no such proportional relationship among its components. It appears as if the sole determinant of the overall duration of these smiles is the duration of their apexes.

These patterns—less variability and more smoothness for smiles with the Duchenne marker than for those without—held regardless of whether the smile was shown in a solitary or social interaction situation. In addition, these results occurred in spite of the finding that there was no mean difference in zygomatic major duration between smiles with or without the Duchenne marker.

Another finding in this study was that the mean duration of the smiles with Duchenne's marker in the social interaction situation supported previous observations that enjoyment smiles are between 0.5 and 4 s in duration (Ekman et al., 1990; Hess & Kleck, 1990). However, the mean duration of this type of smile in the solitary situation was 6.18 s, which seems outside of Ekman and Friesen's (1982) original predicted range. However, there were two outliers in the sample of smiles with the Duchenne marker in the solitary situation: One smile was 25 s long and a second was 17 s long. When these two outliers were dropped, the average length of the Duchenne smiles in the

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[6] As was the case with the overall mean duration analysis, the intensity of zygomatic major action did not covary with duration for any of the constituent components—onset, apex, and offset—of the smiles (all *β*s < .17), $ts(21) < 1.13$, *ns*.

solitary condition was reduced from 6.18 to 4.47 s.[7] This latter figure is quite comparable with the 0.5- to 4-s range proposed earlier (Ekman & Friesen, 1982). However, it should be noted that Ekman and Friesen (1982) based their prediction that enjoyment smiles will range from 0.5 to 4 s in duration on their observations of large data sets that involved social interactions (interviews); this result was replicated in the social interaction situation. Other research has shown that situations can and do have an effect on the duration of zygomatic major actions, depending on the degree of felt presence of other people (Fridlund, 1991). Yet there is no a priori biological or psychological reason why this 0.5- to 4-s duration range is crucial; what is more important in terms of our hypothesis is that the durations of the smiles with the most replicated marker of enjoyment in a given situation clustered around a particular mean, whereas the durations of the smiles without this marker in the same situation were significantly less consistent.

One aspect of this study that makes these results even more compelling is that it used two samples of subjects that were derived from two experiments carried out 15 years apart. Normally, the use of such disparate samples introduces so many possible confounds as to render the results uninterpretable. However, in this study we predicted that there would be no effect of situation on the results. Thus, any other factor that might have differentially impacted the solitary or social interaction situation, such as the presence of electroencephalogram (EEG) caps in the solitary condition, would conspire to work against our hypothesis and against the likelihood that we would obtain evidence for the duration marker in both samples. However, we found virtually the same results in both samples. Thus, this procedure actually adds to the generalizability of our results in a way stronger than a simple replication or two-level manipulation of an independent variable could have.

However, one could still question the solitariness of the solitary situation. Certainly no other person was in the room, the room was darkened, and the subjects were told they would be watching the film in private. Someone committed to the view that despite these conditions, the alone situation was not really solitary could argue that the presence of the EEG lycra skull caps were so obtrusive as to make the subject very aware of her facial expressions. We reject this possibility because it does not seem logical that a cap would make one aware of his or her face. Certainly, EMG electrodes attached to one's face may draw one's attention to his or her face (see Fridlund, Ekman, & Oster, 1987, for a review of issues related to the use of EMG), but it is difficult to imagine how EEG electrodes embedded in a skull cap would do so. It may make a subject become aware of his or her thoughts, but not his or her face.

Finally, enjoyment smiles, manifesting both Duchenne's and the duration markers, occurred in both a social interaction and a solitary situation. These results are incompatible with the view that emotional expressions are solely interactive signals (Kraut, 1982; Smith, 1985) and should not occur when people are alone. Our findings are consistent with the view that the enjoyment smile is one component of an emotion, and emotions can occur when people are alone or in social interaction (Ekman, 1989, 1992). This is not to deny that emotional expressions have social signal value.

Study 2

This study addressed the question of whether the subtle markers of enjoyment can operate as social signals, capable of being distinguished by an untrained, unaided observer. Darwin thought this was possible. Discussing photographs of enjoyment and nonenjoyment smiles that were given to him by Duchenne de Boulogne, Darwin said

> Almost everyone recognized that the one represented a true, and the other a false smile; but I have found it very difficult to decide in what the whole amount of difference consists. It has often struck me as a curious fact that so many shades of expression are instantly recognized without any conscious process of analysis on our part. (Darwin, 1872, p. 359)

Although there have been many studies showing that observers can recognize discrete emotions (cf. review Ekman, 1989), there has been no prior test of whether observers can distinguish a true enjoyment smile from other smiles. Even the studies that examined how well observers could detect deception from facial behavior lumped all forms of smiling into one category and did not determine whether enjoyment smiles could be distinguished from other smiles (see DePaulo, Stone, & Lassiter, 1985; Zuckerman, DePaulo, & Rosenthal, 1981; Zuckerman & Driver, 1985, for reviews).

Only three studies examined the relationship between the type of smiling and observers' inferences about emotion or deception, and they did so only indirectly. One study reported a significant correlation between observers' happiness ratings and a subject's zygomatic major intensity; however, this analysis did not consider different forms of smiling (Hess, Kappas, McHugo, Kleck, & Lanzetta, 1989). A second study found an association between Duchenne-marked smiles and positive attributions by observers; however, it could not be certain that this association was specific to the type of smile observed or some other correlated variable because the observers had watched a videotape that showed diverse facial behavior (O'Sullivan, Ekman, Friesen, & Scherer, 1992). A third study found that children became increasingly unresponsive when interacting with women whose zygomatic major action featured unusual timing features (Bugental, 1986). Again, it is possible that the children's unresponsiveness was due to some other correlated aspect of the womens' behavior.

Not only has there been no study to determine whether observers can detect the difference between an enjoyment and a nonenjoyment smile, but no study has examined which marker of the enjoyment smile—Duchenne or the duration marker—has the clearest signal. We hypothesized that the Duchenne marker would provide a greater social signal than the duration marker for three reasons: (a) Popular lore (e.g., smiling eyes) suggests that the orbicularis oculi action of the Duchenne

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[7] When the corresponding smile without the Duchenne marker is dropped from the sample, the mean duration for these smiles drops to 9.44 s. However, the removal of both types of smiles for these 2 subjects does not change the significance of the test for equality of variances because that test is based on the variance of observations about the 10% trimmed mean of each group (Brown & Forsythe, 1974). In other words, the Brown and Forsythe (1974) technique requires the exclusion of these two data points when computing the F value.

marker is a recognizable signal, whereas there is no such lore for the duration marker; (b) with the Duchenne marker it is possible to determine for each smile whether the relevant action (orbicularis oculi activity) is present or absent. The duration marker does not specify a feature that can be used to decide about each particular smile, but instead a judgment must be made about the variability in duration shown by a group of smiles. (c) One study reported that the variance associated with a subject's zygomatic major action did not predict observers' ratings of a subject's happiness (Hess et al., 1989).

Any factor that would highlight the Duchenne marker (i.e., orbicularis oculi action) should be associated with increased accuracy. One way to highlight the Duchenne marker is to show a group of observers one person displaying two smiles, one showing the Duchenne marker and one not showing Duchenne's marker, and then ask observers to judge which of the pair of smiles is the enjoyment smile. A second group of observers who see only one smile—either with or without the Duchenne marker—and have to judge whether the smile they saw was an enjoyment or a nonenjoyment smile should not do as well. Having the same person show both types of smiles should control the across-person variability of static facial features (particularly the presence of bagging under and wrinkles around the eyes, which resemble orbicularis oculi action), which would occur when a particular person showed only one type of smile, thus making actual orbicularis oculi action stand out. A second way to highlight Duchenne's marker is to use smiles of low zygomatic major intensity. Smiles of high zygomatic major intensity raise the cheek high enough to create many of the same bulges and wrinkles associated with orbicularis oculi action; this creates many instances in which it appears as if Duchenne's marker is present when it is not. Smiles of low intensity do not change the appearance of the face beyond the lips so the action of the orbicularis oculi muscle should be more readily recognized (see Ekman & Friesen, 1978, for more details).

We showed observers a videotape of subjects showing enjoyment and nonenjoyment smiles and asked them to distinguish between these smiles. We hypothesized that (a) enjoyment smiles have a social signal value and can be distinguished from nonenjoyment smiles at rates greater than chance; (b) the Duchenne marker (orbicularis oculi) will have greater signal strength than the duration marker; and (c) factors that enhance the salience of the Duchenne marker's orbicularis oculi action —enjoyment and nonenjoyment smiles that are shown in pairs and smiles of low zygomatic major intensity—will all be associated with increased accuracy in distinguishing enjoyment from nonenjoyment smiles.

Method

Materials. The smiles shown to observers were selected from the sample of subjects whose smiles were analyzed in Study 1. The current sample consisted of all subjects from the group of 44 who had shown at least one enjoyment smile and one nonenjoyment smile that were of identical zygomatic intensity. Overall, 20 enjoyment–nonenjoyment smile pairs were used, with each member of the pair of smiles equivalent across facial muscle movements (except orbicularis oculi). Within these enjoyment and nonenjoyment smile pairs, half of them featured both the Duchenne marker and the duration marker; the remaining half featured the Duchenne marker without the duration marker; that is, the overall duration of nonenjoyment smile was not more than one standard deviation longer or shorter than the overall duration of the enjoyment smiles as reported in Study 1. Ten of these smile pairs came from subjects in the social interaction sample, and 10 pairs came from subjects in the solitary sample. There were 4 pairs of very slight intensity smiles, 9 pairs of slight intensity smiles, and 7 pairs of moderate intensity smiles (as determined by FACS scoring rules; Ekman & Friesen, 1978).

The smiles from these 20 subjects were edited in the same order onto two silent black-and-white videotapes. The first videotape consisted of a random selection of one of the two smiles of a given subject's enjoyment–nonenjoyment smile pair; the second videotapes consisted of the smile from that smile pair not chosen for the first videotape.

Each of these two videotapes was used for separate single smile judgments. The smile pair judgments were created by alternately playing the first and second videotape. This way, the first subject was viewed showing both enjoyment and nonenjoyment smiles consecutively; the second subject was then viewed displaying both smiles, followed by the third subject, and so on. The presentation order of the videotapes for the smile pair judgments was counterbalanced.

Observers. The observers were 34 male and 46 female Cornell University undergraduates who volunteered for the study in return for course extra credit.

Procedure. The observers were run in a classroom setting, with the group size ranging from 1 to 10. They were given an instruction and response sheet that had the following instructions:

> Today you will see brief videotape clips of persons smiling. You are asked to judge whether each smile is a true, genuine expression of enjoyment (i.e., she is truly happy or enjoying herself) or if in fact this smile is a false or social expression (i.e., she is smiling because it is socially appropriate but she is not necessarily happy herself).

For the single smile judgment condition, the next paragraph read:

> After you have made your decision, please circle the word *enjoyment* or the word *social*, depending on which type of smile you believe you saw. You will see 20 people. Exactly half of these smiles are true expressions of enjoyment.

For the smile pair judgment condition, the following was substituted for the previous paragraph:

> You will view each person twice. Observe the first smile, but do *not* circle a response. Then observe the second smile, and at that point judge which one of these smiles was the true enjoyment smile. After you have made your decision, please circle the word *First* or the word *Second* corresponding to which smile you believe was the true expression of enjoyment.

At the end of the session, judges were asked to indicate "what cue(s), clue(s), or strategy(ies) did you use to make your judgments?"

We stated that exactly half of the smiles in the single smile condition would be true enjoyment smiles to make it explicit to observers that they had a 50% chance of making a correct judgment if they guessed. Note that in the smile pair condition observers knew they had a 50% chance because only one of the smiles in the pair was the true enjoyment smile. Thus, this instruction had the effect of rendering the chance levels comparable in the minds of both groups of observers.

Design. This design was a 2 × 2 × 2 factorial, with the independent variables type of judgment (single smile judgment vs. the smile pair judgment), presence of the duration marker (smile pairs in which the nonenjoyment smile did not differ significantly from the enjoyment smile in duration vs. smiles where the nonenjoyment smiles were a standard deviation longer or shorter in duration than the enjoyment smiles) and situation (the social interaction situation vs. the solitary situation), with presence or absence of the duration marker and situation being within-subject comparisons. The dependent variable was the proportion of smiles correctly identified. Subsidiary analyses examined the effect of the intensity of the zygomatic major action of the smile and the effect of the observers' reported strategy on the overall proportion of smiles judged correctly.

Results

Overall analyses. Visual inspection of the data revealed that there were no differences between the ratings made by the 4 subjects who were run alone versus the subjects who were run in groups. Moreover, there were no main or interaction effects for sex of the observer, so these data were collapsed.

Forty observers viewed one of the two single videotapes (single smile judgment), and another 40 observers viewed both videotapes played alternately (smile pair judgment).[8] A 2 × 2 × 2 analysis of variance (ANOVA) revealed, as predicted, that the smile pair comparison condition produced greater accuracy than the single smile comparison. The overall accuracy scores show that the judges who were able to compare a particular subject's enjoyment and nonenjoyment smiles were correct on a mean of 74% of their judgments, compared with 56% for the judges who made single smile comparisons, $F(1, 78) = 42.17$, $p < .0001$. Both these mean accuracy rates are greater than what would be predicted by chance (chance = .50); smile pairs judgment, $t(39) = 12.47$, $p < .001$; single smiles judgment, $t(39) = 2.97$, $p < .01$.

The second hypothesis predicted that the zygomatic major duration marker would not function as a useful clue for distinguishing enjoyment from nonenjoyment smiles; that is, if the duration marker does not have signal value then those smile pairs in which only the enjoyment smile has a mean duration between 0.5 and 4 s will not be more accurately distinguished than smile pairs in which both members are of equivalent duration. The pooled results presented in Table 2 show that those smile pairs in which the nonenjoyment smile featured a significantly longer or shorter duration than the enjoyment smile (i.e., did not feature the duration marker) were actually less accurately judged than those smile pairs that did not show this duration difference, $F(1, 78) = 5.48$, $p < .03$.

Because there was no significant main effect or interaction of situation (the social interaction versus the solitary situation), all $Fs(1, 78) < 1.55$, $p = ns$, the data were collapsed across situation, and the means and standard deviations are presented in Table 2. There were no significant two-way interactions or a significant three-way interaction among these variables.

Subsidiary analyses. It was hypothesized that factors that increased the salience of the Duchenne marker would be associated with increased accuracy. Observers' accuracy scores as a function of the zygomatic major intensity of the smile were examined in a 3 (intensity level of the zygomatic major: very slight, slight, or moderate) × 2 (across vs. within-subject comparisons) ANOVA with repeated measures on intensity. The means are shown in Table 3.

In this analysis[9] there was a significant main effect of intensity of the smile, $F(2, 156) = 3.66$, $p < .04$; individual t tests showed that very slight intensity smiles were marginally more accurately detected than moderate intensity smiles, $t(79) = 1.78$, $.10 > p > .05$, and slight intensity smiles were significantly more accurately detected than moderate intensity smiles, $t(79) = 2.04$, $p < .05$. There was no difference in detectability between the very slight and slight intensity smiles, $t(79) < 1$. There was no significant interaction between intensity and type of judgment, $F(2, 156) = 1.89$, $p > .15$.

It is also interesting to note that there was no difference in detectability in moderate intensity smiles between the observers who made smile pair judgments versus those observers who made single smile judgments, $t(78) = 1.55$, *ns*). However, there were significant differences between single smile and smile pair judgments for both very slight intensity smiles, $t(78) = 4.72$, $p < .001$, and slight intensity smiles, $t(78) = 5.15$, $p < .001$. It seems that the smile pair type of judgment further augments the already enhanced orbicularis oculi action created by the lower zygomatic major action of the very slight and slight intensity smiles.

This explanation would be strengthened if there was any evidence that more clearly indicated that the accurate observers were focusing on the orbicularis oculi action. For this reason the observers written responses to the question "what cue(s), clue(s), or strategy(ies) did you use to make your judgments?" was examined.

The judges' strategies were assigned to one of three categories: (a) *no quantifiable strategy* (like "intuition," "guessed," etc.; 27 observers fell into this category), (b) *oculi strategy*—they

Table 2
Proportion of Correct Judgments by Type of Judgment and by Whether Both the Enjoyment and Nonenjoyment Smile had the Duration Marker

Measure	Type of judgment: Single smile	Smile pair	Pooled
Only enjoyment smile has duration marker			
M	.54	.71	.63
SD	.19	.16	.19
Both smiles have duration marker			
M	.58	.78	.68
SD	.15	.14	.18
Overall accuracy			
M	.56	.74	.65
SD	.13	.12	.15
N	40	40	80

[8] A one-way ANOVA on the accuracy rate revealed that the two single smile videotapes did not significantly differ; likewise, the mean accuracy for the two presentation orders of the smile pair videotapes did not significantly differ. Therefore, the data for the two single smile videotapes were collapsed into one single smile condition, and the data for the two presentation orders for the smile pair videotapes were also collapsed into one smile pair condition.

[9] The single smile versus smile pair main effects were reported earlier in Table 2 and thus will not be repeated here.

Table 3
Proportion of Correct Judgments of Enjoyment and Nonenjoyment Smiles by Smile Intensity and Type of Judgment

Smile intensity	Type of judgment: Single smile	Smile pair	Pooled
Very slight			
M	.55	.78	.67
SD	.22	.21	.24
Slight			
M	.58	.77	.67
SD	.19	.13	.19
Moderate			
M	.55	.68	.61
SD	.16	.16	.18
Overall accuracy			
M	.56	.74	.65
SD	.13	.12	.15
N	40	40	80

Note. Very slight intensity corresponds to Facial Action Coding System (FACS) A score, slight intensity corresponds to FACS B score, and moderate intensity corresponds to FACS C score (Ekman & Friesen, 1978).

mentioned the eyes ("sparkling around the eyes," "crinkling around," etc., 35 observers fell into this category); and (c) *zygomatic strategy*—they mentioned the dynamics of the smile action and duration (length, flow, and unnaturalness; 18 observers fell into this category). A second scorer agreed on 90% of the categorizations (72 out of 80).

A correlational analysis showed a relationship between oculi strategy and observers' accuracy. When the observers' reported strategies were coded so that the no quantifiable strategy and zygomatic strategy are coded as 0 and the oculi strategy coded as 1, a significant positive correlation appeared between oculi strategy and overall accuracy (Pearson $r = +.22$, $p < .05$). A closer examination of this correlation shows that the oculi strategy was most strongly related to accuracy at detecting very slight intensity smiles (Pearson $r = +.26$, $p < .02$); there was no significant correlation between oculi strategy and accuracy for either the slight or moderate intensity smiles (Pearson $rs = +.17$ and $+.09$, respectively).

The zygomatic strategy was not associated with increased accuracy. When no quantifiable strategy and oculi strategy are recoded as 0 and zygomatic strategy is recoded as 1, the correlation between zygomatic strategy and accuracy is (Pearson r) $-.12$. Even when examining those smile pairs that differed in duration, the correlation between zygomatic strategy and accuracy for those items is (Pearson r) $-.16$.

Discussion

Enjoyment smiles have social signal value when observers are focused on the task of distinguishing them from other kinds of smiling. Moreover, this signal is amplified as the action of the orbicularis oculi becomes more conspicuous. Three factors that increase the salience of orbicularis oculi action—allowing observers to compare smile pairs versus single smiles, smiles with weaker zygomatic major intensity, and observers who specifically monitored the eye area of the stimulus subjects' faces —were all associated with increased ability to accurately distinguish enjoyment smiles from nonenjoyment smiles. Moreover, under the circumstances in which the orbicularis oculi is most salient—a smile pair judgment, a slight or very slight intensity smile, and for observers who indicated an oculi strategy—accuracy peaked at 81%! However, it should be noted that the lower intensity smiles with the Duchenne marker are more accurately recognized only when they are shown in a comparison situation; there appears to be no differential accuracy effect in the single smile condition.

The duration marker does not appear to have social signal value. The smile pairs in which the duration marker was made salient when the nonenjoyment smile had a significantly longer or shorter duration than the enjoyment smile are actually less accurately distinguished than the enjoyment–nonenjoyment smile pairs that were of comparable duration. A reason for the reduced accuracy might be that the unusually long or short zygomatic major durations of the nonenjoyment smile may have drawn the observers' attention away from the orbicularis oculi area. This can be reasonably construed from the results of Study 2, which demonstrated that factors that decreased the salience of the orbicularis oculi were associated with decreased accuracy.

Although Study 2 has shown that observers can distinguish enjoyment from nonenjoyment smiles, it does not tell us whether each type of smile conveys different information about the emotional state of the person when observers' attention is not focused on just the smile; this was examined in Study 3.

Study 3

The design of Study 2 provided observers with optimal viewing conditions in which to accurately identify enjoyment smiles by (a) eliminating many potential competing behavioral cues, (b) having the same person show both an enjoyment and nonenjoyment smile in one of the conditions, and (c) drawing observers' attention directly to the smiles by asking them simply to pick which smiles were the true enjoyment smiles. By contrast, in more usual interactions, interactants are instructed neither to observe and categorize each other's smiles, nor to specifically compare one smile with the next within an individual. Study 3 was designed to move one step closer to an actual interpersonal situation by asking observers to form an impression of a person without specifically drawing observers' attention to the smile. It was hypothesized that observers would rate stimulus subjects who showed enjoyment smiles as more pleasant and positive than when they showed a nonenjoyment smile.

Method

Materials. The same two videotapes used in Study 2 were used in this study (see Method section of Study 2 for information on the videotapes).

Observers. Thirty undergraduate observers, 14 from Cornell University (8 women and 6 men) and 16 from Cortland State University (8 women and 8 men), participated in this study for course credit. An equal number of Cornell and Cortland State students saw each of the two single smile videotapes.

Procedure. The observers were run in a classroom setting in groups ranging from 1–11. Fifteen observers saw one of the two videotapes, and 15 observers saw the other; thus, observers saw only one type of smile for each person in the videotapes. They were given an instruction and response sheet that asked them to "rate each of the 20 stimulus subjects across the following 15 adjective pairs that you feel most accurately characterizes this person." It should be noted that the observers were not told that these 20 stimulus subjects would be smiling; they were simply asked to record their impressions of each person.

Fifteen bipolar personality–emotion adjective pairs were adopted from a previous study on subjective judgments of nonverbal behavior (Ekman, Friesen, & Scherer, 1976). They were originally selected for their relevance to personality, emotion, and deception. These 15 adjective pairs were as follows: outgoing–inhibited, expressive–unexpressive, sociable–withdrawn, calm–agitated, natural–awkward, stable–unstable, relaxed–tense, honest–dishonest, sincere–insincere, trustworthy–untrustworthy, dominant–submissive, likable–unlikable, felt pleasant–felt unpleasant, act pleasant–act unpleasant, and genuine–sarcastic.

Design. This study consisted of two independent variables (enjoyment smiles vs. nonenjoyment smiles) and the situation from which the smiles were drawn (social interaction vs. solitary) on the 7-point ratings of the dependent variables (the 15 adjective pairs). Both independent variables were within-subject variables.

Results

Rating analysis. As in Study 2, there were no significant main effects or interactions for sex of observers, or for observers run alone versus observers run in groups, and so these data were collapsed.

The basic assumption of most statistical analyses is that observations remain independent. Because 30 observers made 15 ratings across 20 people, technically each of these 9,000 observations were not independent. Preliminary analyses undertaken to compress the number of observations revealed three findings: (a) combining the observers' impressions of the 20 subjects across the 15 adjective pairs showed that all of the trait term ratings correlated positively ($r > +.17$) with each other at significance levels of $p < .05$ or stronger (Cronbach's alpha across the 15 trait terms = .92); (b) when these ratings were factor analyzed with a varimax rotation, they revealed a strong first factor on which all 15 of the adjective pairs loaded greater than +.48 (the three highest loading traits were felt pleasant, +.94; act pleasant, +.89; and likable, +.86); and (c) this first factor accounted for 53% of the variance. Therefore, for each observer, the 15 adjectives were summed and averaged within each of the 20 stimulus subjects. This created what we called a *general positivity* score for each of the 20 stimulus subjects, within each observer. These were the data analyzed in a 2 (type of smile) × 2 (situation) within-subjects ANOVA.[10]

The means for the general positivity scores were first reflected so that the higher numbers would equal higher positivity; these reflected results are presented in Table 4. The results of the ANOVA showed a significant main effect such that the videotape clips containing people showing enjoyment smiles were seen as more positive than the videotape clips containing these same people showing nonenjoyment smiles, $F(1, 29) = 11.93$, $p < .001$. There was also a significant main effect for situation, which indicated that subjects in the social interaction situation were seen as generally more positive, independent of smile type, than subjects in the solitary situation, $F(1, 29) = 12.74$, $p < .001$. There was no significant interaction of smile and situation, $F(1, 29) = 0.01$, *ns*, again suggesting that enjoyment smiles have a social signal independent of situation. It seems clear that when the 20 stimulus subjects showed enjoyment smiles they created a distinctly different and more positive impression in the eyes of the observers than when they showed nonenjoyment smiles of equal zygomatic intensity.

Table 4
Mean Positivity Ratings by Type of Smile and Situation

Type of smile	Situation: Social interaction	Situation: Solitary	Pooled
Enjoyment smile			
M	4.75	4.07	4.41
SD	0.62	0.76	0.76
Nonenjoyment smile			
M	4.42	3.49	3.96
SD	0.79	0.34	0.76
Pooled			
M	4.59	3.78	
SD	0.68	0.44	
N	30	30	

Note. Higher numbers equal more positivity.

Signal value across Studies 2 and 3. Because both Study 2 and Study 3 used the exact same videotapes (i.e., the same 20 stimulus subjects showing the same facial behavior), the net difference in the general positivity scores between the enjoyment and nonenjoyment smiles for each of the 20 stimulus subjects were correlated with the average enjoyment smile detection accuracy of these same 20 stimulus subjects reported in Study 2 (the average single smile accuracy). These items correlated (Pearson r at +.56, $p < .025$). This means that for each of the 20 stimulus subjects, the more accurately a given subject's enjoyment smile was distinguished from her nonenjoyment smile by the observers in Study 2, the more positive this same subject's enjoyment smile was rated relative to her nonenjoyment smile by the observers in Study 3. Ultimately, it appears as if the factors that contributed to an observer's ability to distinguish enjoyment smiles from nonenjoyment smiles also contributed to an observer's relatively greater positive impression of people when they display enjoyment smiles compared with when they display nonenjoyment smiles.

Discussion

The social signal value of an enjoyment smile is not limited to explicit judgments (as in Study 2); the results of Study 3 reveal that subjects who show enjoyment smiles are seen as more expressive, natural, outgoing, sociable, relaxed, feel and act more pleasant—generally speaking, as more positive—than when

[10] Given the results of Study 2, as well as the more general focus on the enjoyment smile, the absence or presence of the duration marker was not included in this analysis.

they show nonenjoyment smiles. Observers formed these impressions even though they were not instructed to focus on either the smile or any differences between the types of smiles. When the task was shifted from making explicit distinctions between types of smiles to forming impressions of people based on facial behavior, which is more like the task one faces in everyday life, it appears as if the social signal survives.

One finding in this study was that subjects in the solitary situation were rated as generally less positive than subjects in the social interaction condition. In all likelihood, this result was an artifact attributed to the subjects' unattractive bullet-head appearance created by the EEG lycra stretch caps they wore. However, the positivity scores for the different smile types did not interact with the positivity of the situations and therefore does not becloud the main finding that enjoyment smiles create a more positive impression in observers than do nonenjoyment smiles, independent of situation.

One alternative explanation for these results is given that all the positive attributes were on one pole and the negative on the other, it may be the case that the trait positivity of these scales was confounded with an acceptance or rejection set (Bentler, Jackson, & Messick, 1971). We believe that we can reject this explanation because we were not interested in the impressions created by smiles, per se, but by the difference in impressions created by enjoyment smiles versus nonenjoyment smiles. First, if there was no difference in the signal value of enjoyment and nonenjoyment smiles, then any acceptance or rejection set would function equally on the ratings of both types of smiles. Second, this acceptance–rejection set would push the rating toward the positive end of the scale, particularly in light of the finding that people who smile are seen quite positively (e.g., O'Sullivan et al., 1992). This reduced range would work against the hypothesis because it would make it harder to document a difference in ratings for smiles on a scale with a functional size of 5 rating points versus a scale with 7 rating points. Obtaining the results of this study under these conditions again speaks for the robustness of the phenomenon.

General Conclusion

In sum, the results of these three studies show that there are not only multiple physical differences between enjoyment smiles and nonenjoyment smiles, but also these differences are observable and influence subjective impressions. Study 1 showed that enjoyment smiles are marked not only by orbicularis oculi activity as first noted by Duchenne but also by a more limited time duration than nonenjoyment smiles. Moreover, this study also showed that enjoyment smiles feature a more fixed relationship among its components than do nonenjoyment smiles. This pattern of results occurred across situations involving both isolation and social interaction.

Study 2 showed that another difference between enjoyment and nonenjoyment smiles is that enjoyment smiles have distinctive social signals. Even when smile intensity is controlled, they can be explicitly identified across two interpersonal situations. This social signal seems to reside primarily in the orbicularis oculi (Duchenne smile) marker and not in the zygomatic major duration marker. Any factor that resulted in the increased prominence of the orbicularis oculi action resulted in greater accuracy at distinguishing enjoyment smiles from nonenjoyment smiles.

Study 3 showed that even when the observers were not asked to attend to differences in smiling, the different forms of smiling were associated with different subjective impressions. A person is seen as more positive when they display an enjoyment smile compared with when they display a nonenjoyment smile, again independent of the situation in which the smile is elicited. Finally, it appears as if those enjoyment smiles that were more accurately distinguished from their corresponding nonenjoyment smiles were also responsible for creating relatively greater positive impressions in the observers for the enjoyment smile compared with the corresponding nonenjoyment smile.

It seems reasonable to conclude that the enjoyment smile is lawful behavior and that some of the features operate independent of context, as Ekman and Friesen (1982) had predicted. The enjoyment smile behaves in a fashion much more consistent with emotional, extrapyramidally driven facial actions than do other types of nonenjoyment smiles. These other smiles behave in a fashion similar to other forms of volitionally controlled muscle movements. Thus, the enjoyment smile seems to be a facial behavior clearly separate from the category of facial behavior referred to as the smile. Moreover, the enjoyment smile is related to the internal emotional state of the individual in a way that other smiles are not; this is true on the level of self-report ratings (Ekman et al., 1990; Ekman et al., 1980), behavioral observations (Bugental, 1986; Fox & Davidson, 1988; Matsumoto, 1986; etc.) and CNS measures (Davidson et al., 1990; Ekman et al., 1990).

The notion that a smile is not related to an individual's inner state (e.g., Birdwhistell, 1970; Bruner & Taguiri, 1954; Kraut & Johnston, 1979; Landis, 1924; Smith, 1985) was probably based on a failure to observe the morphological and dynamic markers that distinguish enjoyment smiles from other, nonenjoyment smiles. Unfortunately, much research on the smile still fails to embrace markers of the enjoyment smile. For example, a recent study, which did not take into account either the Duchenne marker or the duration marker, reported no relationship between the amount of zygomatic major activity and self-report of happiness (Fridlund, 1991). However, research on Duchenne's marker has demonstrated that it is the amount of zygomatic activity in conjunction with orbicularis oculi that predicts a subject's self-report of happiness or enjoyment and not the total amount of zygomatic activity (Ekman et al., 1990).

Although our studies have shown that enjoyment smiles can have social signal value, they did not show that they typically do have social signal value. We do not know if people will attend to and use this behavioral clue when they are not explicitly asked to do so and when their attention is not focused on just this one piece of behavior, although this is suggested by the studies cited herein. Further research is needed to determine if the signal value will survive when the enjoyment smile is reembedded into its normal day-to-day context, competing for attention with not only other facial expressions, but also tone of voice, word choice, body motions, and so on. However, for now we can conclude that the enjoyment smile differs not only in morphology but also in dynamics and social signal value from the more general category of facial behavior referred to as the smile.

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Received September 9, 1991
Revision received June 11, 1992
Accepted July 30, 1992 ■