

# The Influence of Forehead, Brow, and Periorbital Aesthetics on Perceived Expression in the Youthful Face

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**Background:** The purpose of this study was to characterize the relative influence of eyebrow position and shape, lid position, and facial rhytides on perceived facial expression as related to blepharoplasty, with a specific focus on the perception of tiredness.

**Methods:** A standardized photograph of a youthful upper face was modified using digital imaging software to independently alter a number of variables: brow position/shape, upper/lower lid position, pretarsal show, and rhytides. Subjects ( $n = 20$ ) were presented with 16 images and asked to quantify, on a scale from 0 to 5, the presence of each of seven expressions/emotions as follows: “surprise,” “anger,” “sadness,” “disgust,” “fear,” “happiness,” and “tiredness.”

**Results:** Statistically significant values for tiredness were achieved by changes of increasing and decreasing the pretarsal skin crease, lowering the upper eyelid, and depressing the lateral brow. Happiness was perceived by elevation of the lower lid or the presence of crow’s feet. Brow shape had a greater influence than absolute position on perceived expression. Elevation of the lateral brow was perceived as surprise, whereas depression of the medial brow and rhytides at the glabella were perceived as anger and disgust. Elevation of the medial brow elicited a minimal increase for sadness.

**Conclusions:** This study showed that the perception of tiredness is most affected by the length of pretarsal lid height (e.g., ptosis). Surprisingly, simulating the skin resection of an upper blepharoplasty results in a paradoxical increase in the perception of tiredness as well. Modifications of brow contour elicit profound changes in perceived facial mood to a greater degree than absolute brow position. (*Plast. Reconstr. Surg.* 121: 1793, 2008.)

Recent refinements in rejuvenative procedures of the brow and periorbital region make it possible to create subtle alterations in facial features. Techniques such as open or endoscopic brow lifts, blepharoplasty, corrugator muscle resection, botulinum and fat injections, and fat grafts clearly succeed in repositioning the brow, removing skin excess, and reducing facial rhytides—but to what effect?<sup>1–9</sup> Many patients seeking a blepharoplasty state that they always look tired, even if they do not feel that way.

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The goals of forehead rejuvenation have been guided by the notion that there exists a standard ideal aesthetic. Numerous attempts have been made to define this ideal in terms of various angles, curves, and proportions.<sup>10–13</sup> However, these mathematical measures are limited in their ability to discriminate attractive from unattractive faces. Does the eyebrow always need to be positioned? Why is scleral show acceptable in some? What is the effect of removing fat and excess skin from the upper lid?

Although the notion of ideal beauty remains elusive, perhaps we can gain more insight from the study of facial expressions. The eyes and the periorbital structures may be able to convey a wide range of expressions, representing a critical nonverbal

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form of communication that is fundamental to our social interactions,<sup>14–16</sup> and should be a factor in how we select various eyebrow/eyelid rejuvenative procedures. The purpose of the present study was to characterize the relative influence of eyebrow position and shape, lid position, and facial rhytides on perceived expression in the youthful face.

## PATIENTS AND METHODS

A standardized photograph of a youthful upper face was analyzed (Fig. 1). Digital imaging software (Adobe Photoshop 3.0; Adobe Systems, Inc., San Jose, Calif.) was used to independently alter a number of variables, including brow position and contour; upper and lower lid position; upper lid hooding and skin resection; and rhytides at the forehead (transverse forehead, vertical, glabellar, and horizontal radix), brow, and crow's feet areas (Table 1).

Twenty subjects were administered a questionnaire, and 16 images were presented to each of them. The 20 subjects were all health care workers (14 women and six men). For each image, they were asked to quantify on a scale of 0 to 5 the presence of each of seven expressions or emotions—"surprise," "anger," "sadness," "disgust," "fear," "happiness," and "tiredness"—with 0 being the lowest and 5 being the highest rating. Results

for each variable were compared with scores for the neutral (unmodified) image (Fig. 1). Significance was determined using a paired *t* test and Microsoft Excel (Microsoft Corp., Redmond, Wash.) ( $p < 0.05$ ). No correction was made for multiple testing.

## RESULTS

The results both confirm some assumptions and challenge others that exist regarding the effect of periorbital anatomy on perceived facial expression. The major finding is that a tired ap-

**Table 1. Anatomical Variables**

Brow	Whole brow elevation	Whole brow depression
	Lateral brow elevation	Lateral brow depression
	Medial brow elevation	Medial brow depression
Eyelid	Upper eyelid elevation	Upper eyelid depression (ptosis)
	Lower eyelid elevation	Lower eyelid depression (scleral show)
	Pretarsal show increased (skin resection)	Pretarsal show decreased (hooding)
Rhytides	Transversal forehead	
	Vertical glabella	
	Horizontal radix	
	Crow's feet	



**Fig. 1.** Normal, unmodified neutral face with which the modified pictures are compared. The unmodified neutral face was perceived as happy by the tested individuals. The horizontal axis represents the means of the ratings.



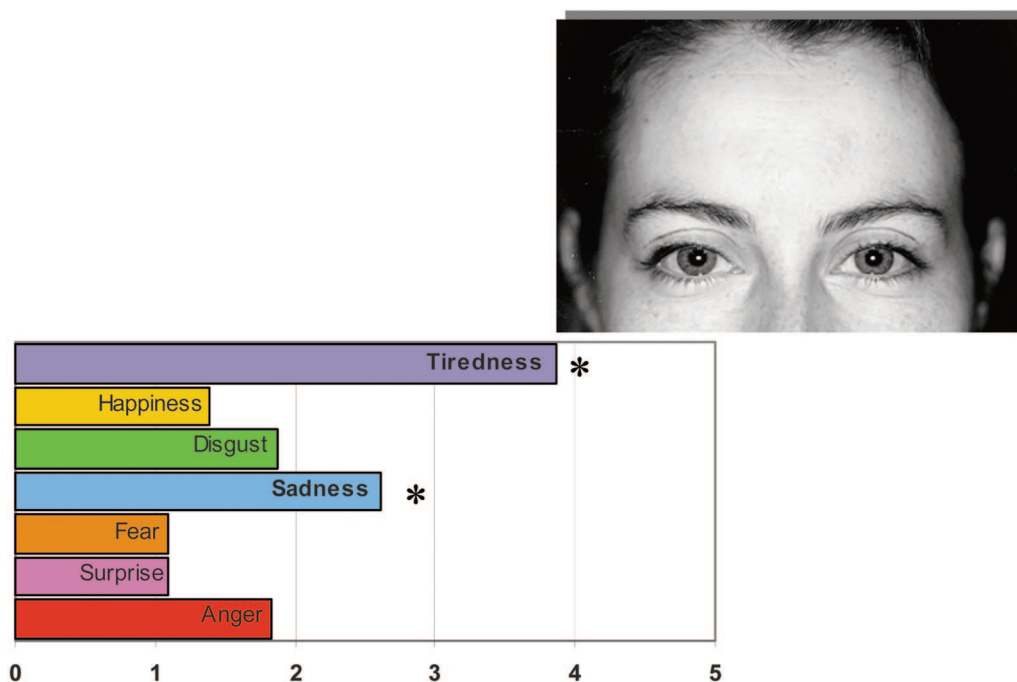
pearance is created most dramatically by ptosis of the upper lid. Surprisingly, we found that simulating the skin resection of the upper eyelid also increased the perception of tiredness ( $p < 0.05$ ) (Fig. 2). Elevating the brow also increased the perception of tiredness and decreased pretarsal show (hooding) ( $p < 0.05$ ) (Figs. 3 and 4). The common theme of these findings is that increased distance between the eyebrow and the upper lid margin results in the perception of tiredness. Expressions of anger and disgust are created with depression of the medial brow (Fig. 5) ( $p < 0.05$ ), when rhytides are present at the radix (Fig. 6) ( $p < 0.05$ ) and the glabella (image not shown) ( $p < 0.05$ ). Expressions of surprise and fear are created with upper lid elevation ( $p < 0.05$ ) (Fig. 7), more so than with elevation of the lateral brow ( $p < 0.05$ ) (Fig. 8). Likewise, expression of sadness is created with elevation of the medial brow ( $p < 0.05$ ) (Fig. 9).

The effect of lower lid position showed that mild scleral show did not increase the perception of tiredness or sadness (image not shown). However, elevation of the lower lid strongly increased the perception of happiness ( $p < 0.05$ ) (Fig. 10).

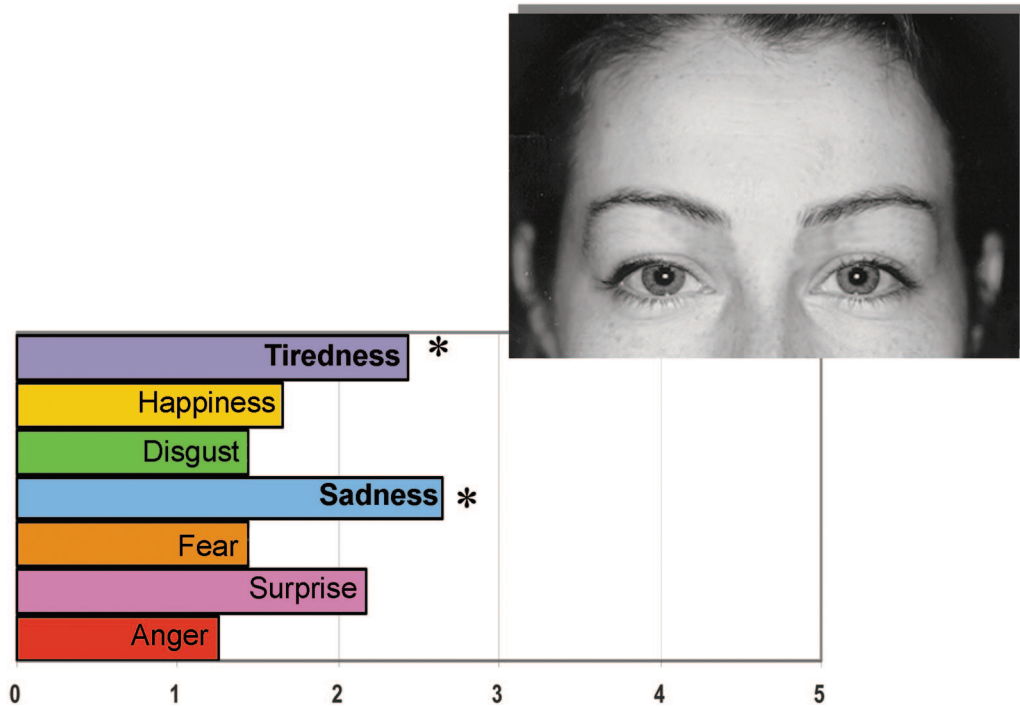
Brow shape had a greater influence than absolute brow position on perceived mood. Elevation of the lateral brow produced a greater than two-fold increase in scores for perception of sur-

prise ( $p < 0.05$ ) (Fig. 8), whereas depression of the medial brow produced a nearly three-fold elevation in scores for anger and disgust ( $p < 0.05$ ) (Fig. 5). Elevation of the medial brow elicited a smaller but statistically significant increase in scores for sadness ( $p < 0.05$ ) (Fig. 9), whereas depression of the lateral brow produced a minimal but not statistically significant increase in scores for tiredness (image not shown). Depression of the whole eyebrow did not result in a statistically significant change (image not shown).

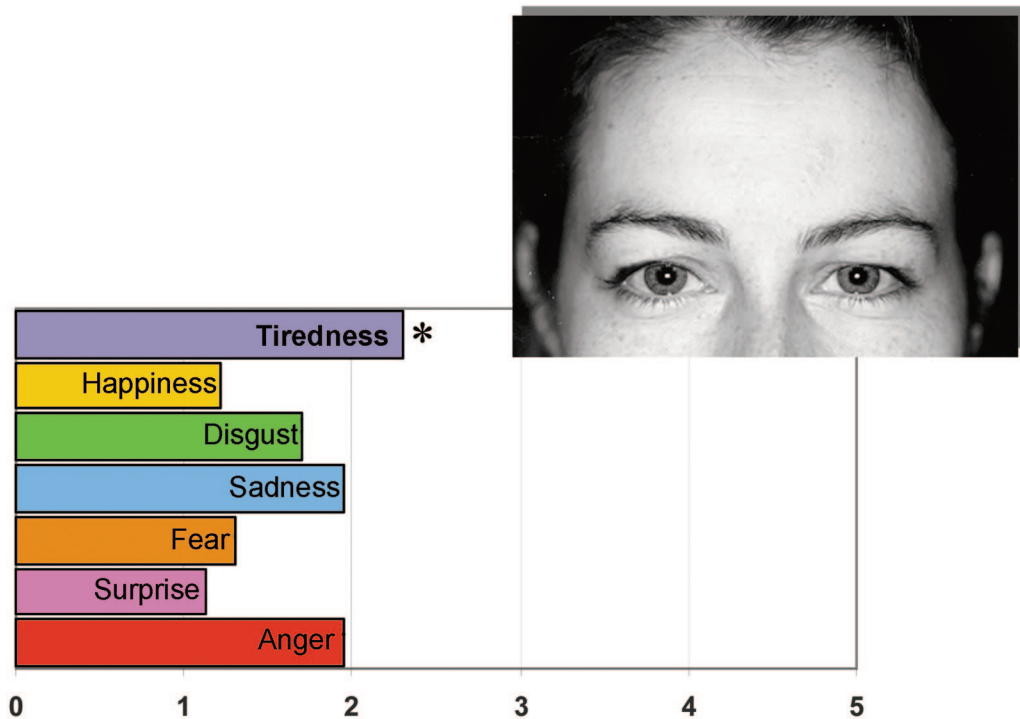
With regard to lid position, lowering the upper lid (ptosis) produced a greater than two-fold increase in scores for tiredness ( $p < 0.05$ ) (Fig. 11). Increasing pretarsal show (simulating the skin resection of an upper blepharoplasty) resulted in a nearly three-fold increase in scores for tiredness ( $p < 0.05$ ) (Fig. 2). Elevation of the lower lid produced a nearly two-fold increase in scores for happiness ( $p < 0.05$ ) (Fig. 10). The presence of facial rhytides at the glabella and radix elicited a moderate increase in scores for anger and disgust, whereas crow's feet resulted in a two-fold increase in scores for happiness (Fig. 12) ( $p < 0.05$ ) (Table 2). The presence of transverse forehead rhytides showed a statistical nonsignificant increase in perception of tiredness and surprise (image not shown).



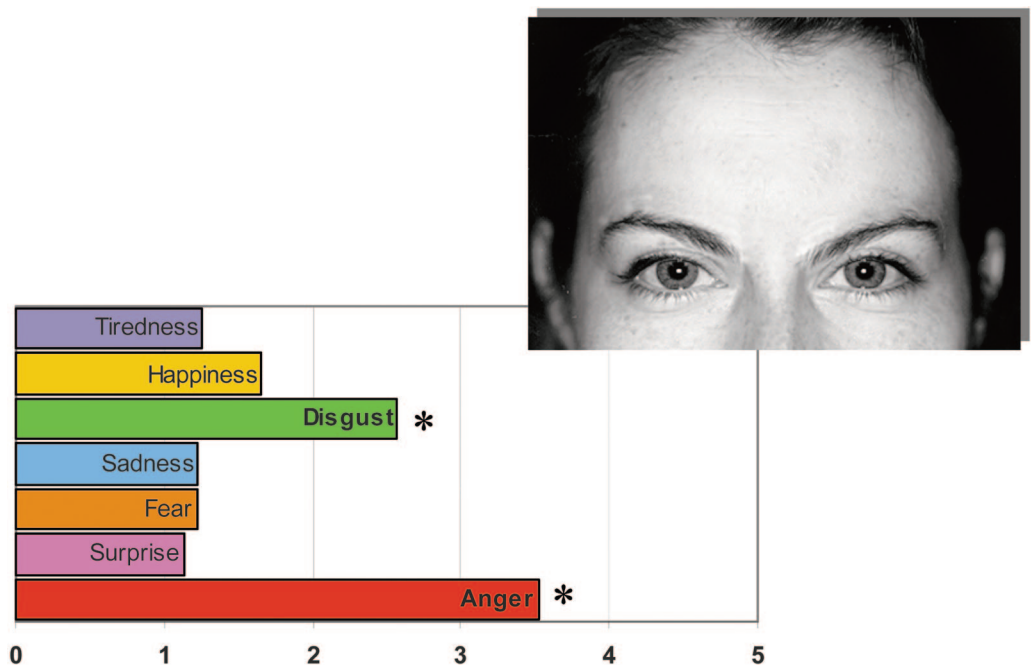
**Fig. 2.** Pretarsal show was increased, leading to an increased perception of tiredness and sadness. Statistical significance for the individual facial expressions is indicated with an asterisk ( $p < 0.05$ ). The horizontal axis represents the means of the ratings.



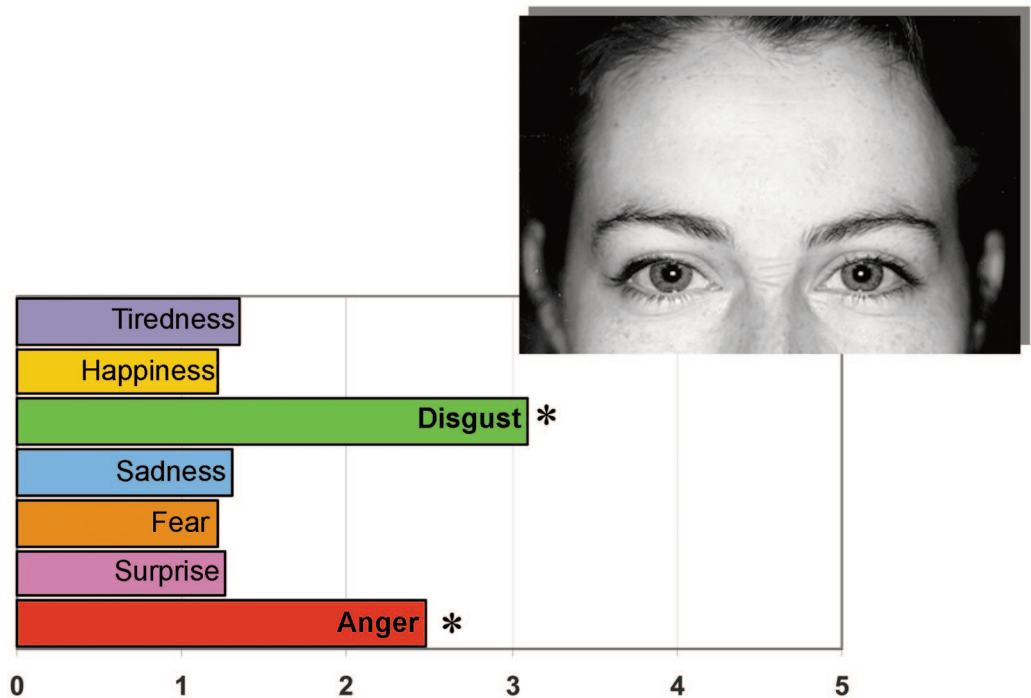
**Fig. 3.** Total eyebrow elevation was perceived as a sad and tired facial expression. Statistical significance for the individual facial expressions is indicated with an *asterisk* ( $p < 0.05$ ). The horizontal axis represents the means of the ratings.



**Fig. 4.** Hooding, or decreased pretarsal show, was perceived primarily as tiredness. Statistical significance for the individual facial expressions is indicated with an *asterisk* ( $p < 0.05$ ). The horizontal axis represents the means of the ratings.

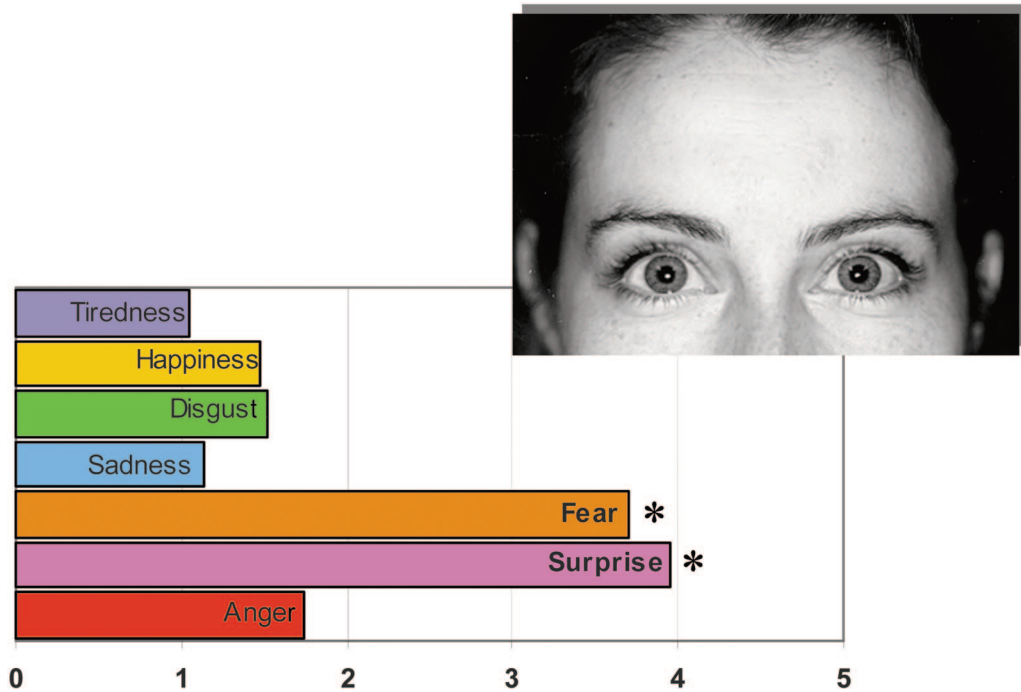


**Fig. 5.** A significant increase in perceived facial expression of anger and disgust was achieved with medial eyebrow depression. Statistical significance for the individual facial expressions is indicated with an asterisk ( $p < 0.05$ ). The horizontal axis represents the means of the ratings.

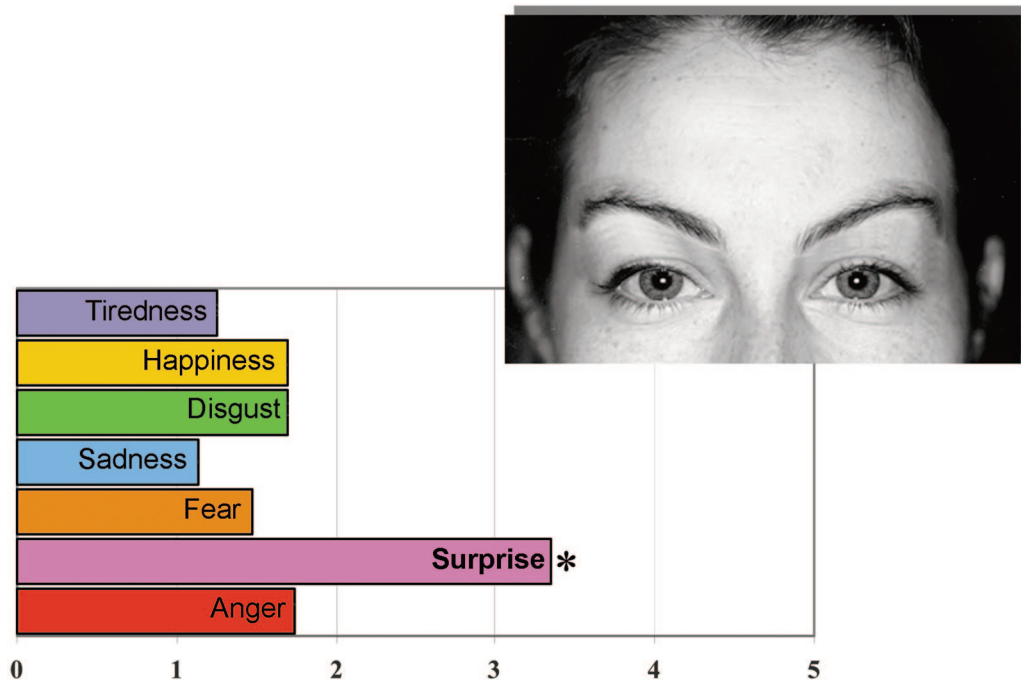


**Fig. 6.** Disgust and anger were perceived with the presence of rhytides of the radix. Statistical significance for the individual facial expressions is indicated with an asterisk ( $p < 0.05$ ). The horizontal axis represents the means of the ratings.





**Fig. 7.** Upper lid elevation was perceived as surprise and fear. Statistical significance for the individual facial expressions is indicated with an *asterisk* ( $p < 0.05$ ). The horizontal axis represents the means of the ratings.

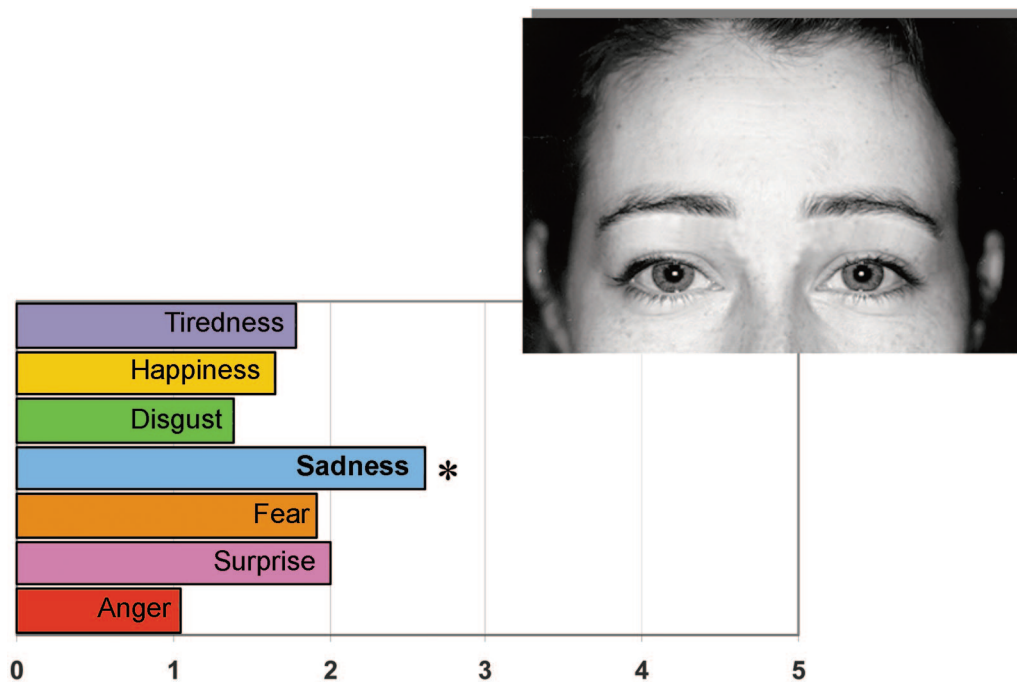


**Fig. 8.** Lateral brow elevation led to an increased perception of surprise. Statistical significance for the individual facial expressions is indicated with an *asterisk* ( $p < 0.05$ ). The horizontal axis represents the means of the ratings.

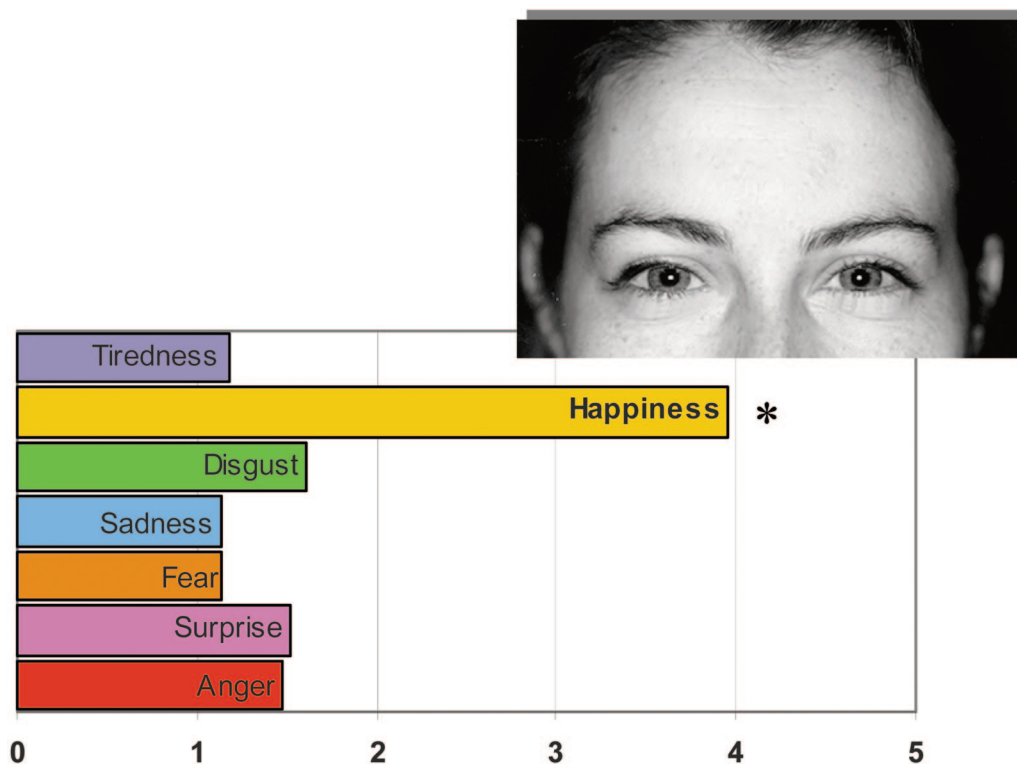
## DISCUSSION

Facial interpretation is considered to be among the most important acquisitions in development.<sup>15</sup> Expressions of happiness, sadness,

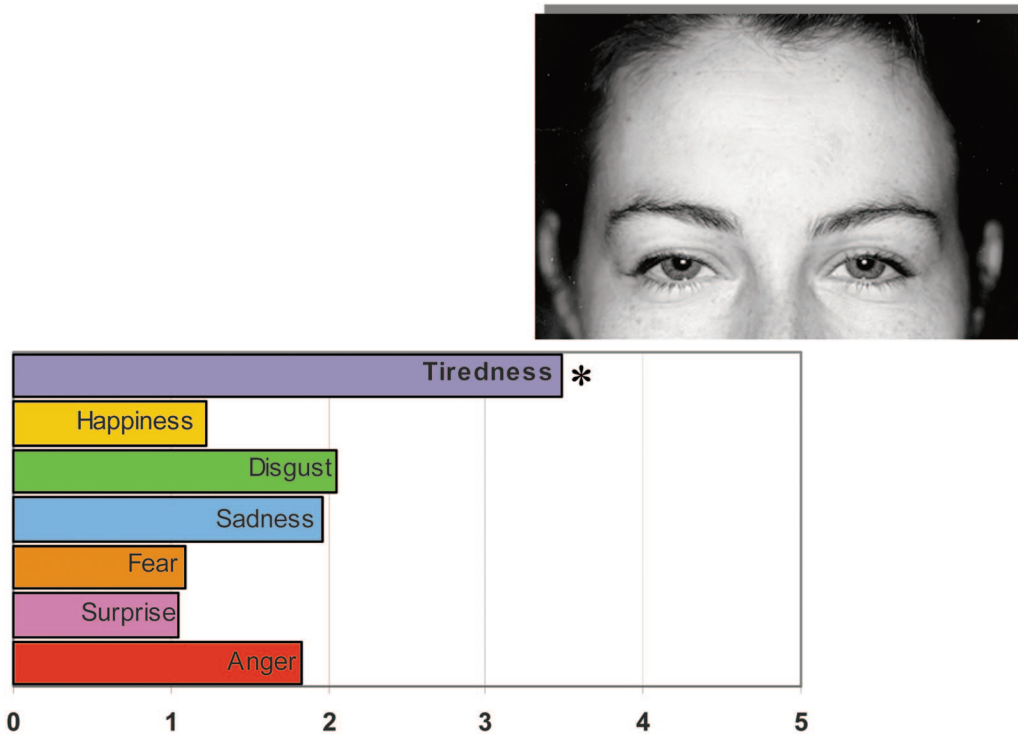
fear, anger, and surprise appear to cross cultural lines and may be considered universal means of nonverbal communication. As such, they provide a more appropriate standard by which to judge the



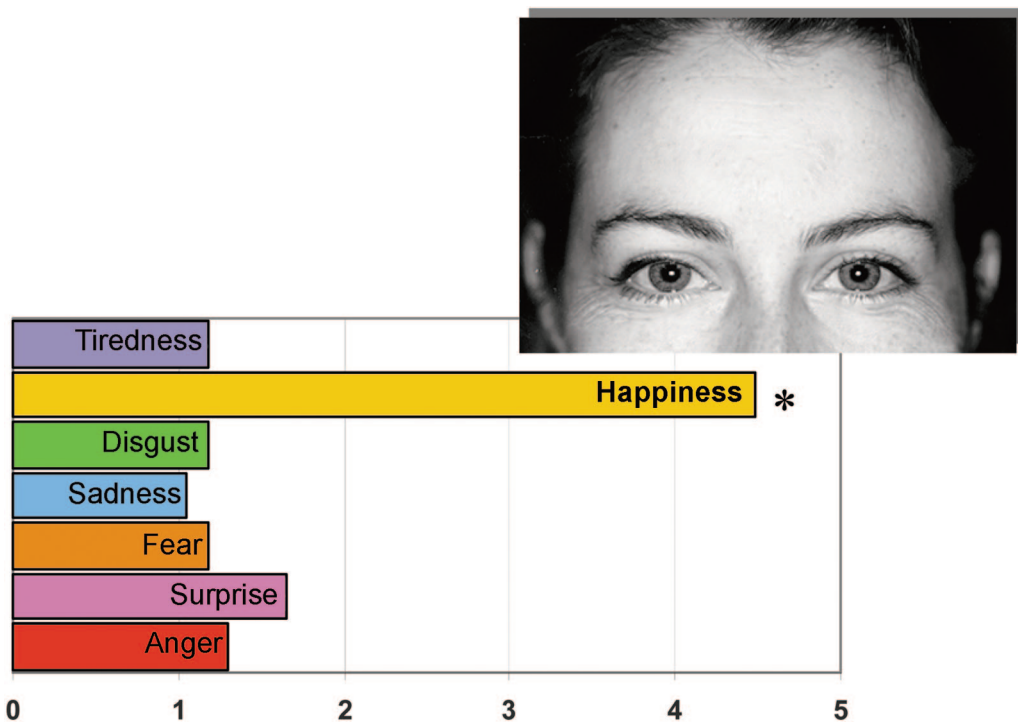
**Fig. 9.** Medial brow elevation was perceived as a sad facial expression. Statistical significance for the individual facial expressions is indicated with an asterisk ( $p < 0.05$ ). The horizontal axis represents the means of the ratings.



**Fig. 10.** Lower eyelid elevation was perceived as happiness. Statistical significance for the individual facial expressions is indicated with an asterisk ( $p < 0.05$ ). The horizontal axis represents the means of the ratings.



**Fig. 11.** Upper lid depression, simulating upper eyelid ptosis, was perceived as tiredness. Statistical significance for the individual facial expressions is indicated with an *asterisk* ( $p < 0.05$ ). The horizontal axis represents the means of the ratings.



**Fig. 12.** The presence of crow's feet led to a perceived facial expression of happiness. Statistical significance for the individual facial expressions is indicated with an *asterisk* ( $p < 0.05$ ). The horizontal axis represents the means of the ratings.



**Table 2. Results of the Anatomical Variations**

	Anatomical Variation	Expression/Emotion
Brow	Whole brow elevation	Tiredness/sadness
	Whole brow depression	No significant change
	Medial brow elevation	Sadness
	Medial brow depression	Anger/disgust
	Lateral brow elevation	Surprise
	Lateral brow depression	No significant change
Eyelid	Upper lid elevation	Surprise/fear
	Upper lid depression (ptosis)	Tiredness
	Lower lid elevation	Happiness
	Lower lid depression (scleral show)	No significant change
	Pretarsal show decreased (hooding)	Tiredness
	Pretarsal show increased (skin resection)	Tiredness/sadness
Rhytides	Vertical glabellar	Anger/disgust
	Horizontal radix	Anger/disgust
	Crow's feet	Happiness
	Transverse forehead	No significant change

effect of the surgical manipulation of facial features.<sup>15–19</sup> Individuals perceived as attractive are held in high regard concerning character, skills, behavior, and other traits. In short, physical attractiveness may influence one's self-image and confidence<sup>20,21</sup> and impact favorably on quality of life. Therefore, an undesirable change in facial expression would have a significant negative impact on the psyche of the patient undergoing rejuvenative surgery of the upper face.<sup>22</sup> We have shown in the youthful face that alterations in brow contour elicit profound changes in perceived facial expression and do so to a greater degree than absolute position of the brow.

A forehead lift is a common adjunct for the treatment of eyebrow ptosis. Matarasso and Terino<sup>12</sup> have reported that a significant percentage of patients seek surgery of the upper third of the face not only for rejuvenative reasons but also for a change of an unattractive expression. Patients wanted their eyebrow position changed to improve their expression of tiredness, sadness, and anger.

Expressions of tiredness and sadness were caused in our study by total eyebrow elevation (Fig. 3) and minimally by lateral brow depression. Surprisingly, simulating the skin resection of an upper blepharoplasty results in a paradoxical increase in the perception of tiredness. Perhaps increasing the exposure of the pretarsal skin gives the illusion of a longer, more ptotic lid and thus a tired appearance. Anthropometric measure-

ments have shown an increase in the upper lid sulcus height after blepharoplasty.<sup>23</sup> However, the results of the anthropometric measurements were somewhat limited because they were indirect measurements from photographs instead of direct measurements of the patient's face. However, this is supportive evidence for the observations that we made in our study: increasing pretarsal show (simulating the skin resection of an upper blepharoplasty) resulted in a nearly three-fold increase in scores for perception of tiredness (Fig. 2). Lowering the upper lid (ptosis) produced a greater than two-fold increase in scores for tiredness (Fig. 11). Scleral show illustrated a mild increase in the scores for tiredness, disgust, and surprise that were not statistically significant. This finding supports the need to correct any eyelid ptosis at the time of blepharoplasty surgery, as the uncovering of the supratarsal crease may be perceived as increased tiredness.

Positively perceived were an elevation of the lower lid (Fig. 7) and crow's feet (Fig. 12), producing high scores for perception of happiness. It seems that both simulate the cheek elevation that occurs with smiling and are perceived accordingly. Perception of surprise was caused mainly by elevation of the lateral brow (Fig. 8) and upper lid elevation (Fig. 7).

Perceptions of anger and disgust were produced by depression of the medial brow (Fig. 5) and facial rhytides at the glabella and radix (Fig. 6). The presence of transverse forehead rhytides may have a lesser impact than generally perceived related to perception of tiredness and surprise.

## CONCLUSIONS

The acceptance of a postoperative result is dependent not only on the reapproximation of what youth should be but also on the social reflections that are perceived by others. Acceptance of body image, whether the patient is satisfied or not with the result, depends on the reactions and attitudes of the social surroundings.<sup>24</sup> In rejuvenative surgery, what appears favorable in one patient may not be a desirable outcome in another patient.<sup>25–28</sup> This may be related to undesirable, unattractive changes in perceived facial expression. Although achieving symmetry and optimal shaping is an ideal, actually obtaining the optimal result may not be technically challenging. The lessons to be learned from this study are summarized as follows:

1. Great attention should be paid not only to elevate the upper lid but also to correct any

preexisting ptosis, which can be easily overlooked in patients with severe dermatochalasis.

2. One's focus should be more directed toward the eyebrow shape rather than toward the absolute elevation.
3. The lower lid position may not influence the perception of tiredness as much, and may be more a result of other factors such as fat herniation or the descent of the midfacial fat.

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