

# The influence of lower face vertical proportion on facial attractiveness

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**SUMMARY** This study investigated the influence of changing lower face vertical proportion on the attractiveness ratings scored by lay people.

Ninety-two social science students rated the attractiveness of a series of silhouettes with normal, reduced or increased lower face proportions. The random sequences of 10 images included an image with the Eastman normal lower face height relative to total face height [lower anterior face height/total anterior face height (LAFH/TAFH) of 55 per cent], and images with LAFH/TAFH increased or decreased by up to four standard deviations (SD) from the Eastman norm. All the images had a skeletal Class I antero-posterior (AP) relationship. A duplicate image in each sequence assessed repeatability. The participants scored each image using a 10 point numerical scale and also indicated whether they would seek treatment if the image was their own profile.

The profile image with normal vertical facial proportions was rated by the lay people as the most attractive. Attractiveness scores reduced as the vertical facial proportions diverged from the normal value. Images with a reduced lower face proportion were rated as significantly more attractive than the corresponding images with an increased lower face proportion. Images with a reduced lower face proportion were also significantly less likely to be judged as needing treatment than the corresponding images with an increased lower face proportion.

## Introduction

In non-growing patients with vertical skeletal discrepancies, the orthodontist is often faced with the choice of either accepting the skeletal discrepancy or correcting it using surgical orthodontic treatment. The decision is partly influenced by the risks of surgical orthodontic treatment, which are known to outweigh those of orthodontic treatment on its own (Dimitroulis, 1998). The size of the skeletal discrepancy is another important factor, with surgical treatment being used for the correction of more severe skeletal discrepancies (Proffit and Fields, 2000). At present, the decision to use surgery or not relies heavily on the subjective judgement of the clinicians involved and the patient's perception of their facial appearance. Unfortunately, there is no clear definition of the range of acceptable lower face proportion to inform this decision-making process.

Several studies have assessed the attractiveness of antero-posterior (AP) skeletal discrepancies (Kerr and O'Donnell, 1990; Phillips *et al.*, 1995; Maganzini *et al.*, 2000). Cochrane *et al.* (1999) manipulated photographs of four subjects with Class I profiles to produce Class II, Class III and long face profiles, with orthodontists, oral surgeons, dental students and lay people ranking the attractiveness of these groups. Although the Class I images were ranked as the most attractive, the long face profiles were ranked as more attractive than the Class III

and Class II images. However, this study did not examine the relationship between the level of deviation from the normal facial profile and the attractiveness ratings recorded.

De Smit and Dermaut (1984) investigated the attractiveness of two vertical and two AP profile silhouettes. They concluded that vertical profile characteristics were more important than AP features. They also concluded that a reduced lower facial proportion was more acceptable to the dental students involved in the study than an increased lower facial proportion. Michiels and Sather (1994) also found that profiles with reduced vertical proportions were rated as more attractive than those with increased lower face vertical proportions by a group of orthodontists and surgeons. Conversely, when Erbay and Caniklioglu (2002) asked a group of orthodontists to rank photographs of Turkish adults, the lower face vertical proportions were found to be significantly greater in the images rated as attractive compared with those rated as unattractive.

Defining beauty and attractiveness is a complex topic, but it is increasingly recognized that what is beautiful or attractive to the orthodontist or surgeon based on their experience and/or training may not agree with what the patient or other individuals think is beautiful or attractive (Giddon, 1983; Hunt *et al.*, 2002). Other studies have confirmed that dental professionals are conditioned to take

an overly critical view of any deviation from normal facial appearance (Shaw *et al.*, 1975; Prah-Andersen, 1978).

The aim of the present study was to define, in an objective manner, the range of acceptable lower face vertical proportion. A panel of lay people was used to rate the attractiveness of a range of facial profiles where lower face height as a proportion of total face height was increased or decreased from normal by standardized increments.

## Subjects and methods

### Profile images

Attractiveness ratings were obtained from visual assessment of a series of facial profile silhouettes representing a range of vertical lower facial proportions.

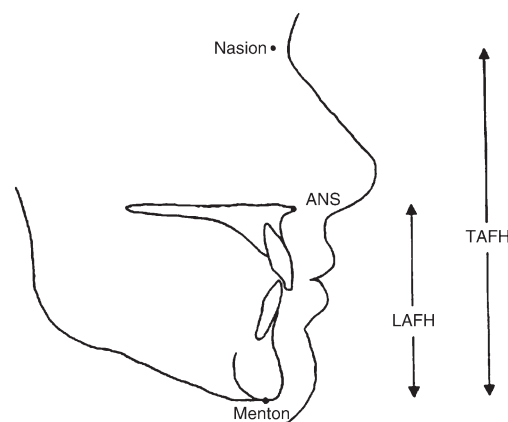
A cephalometric film was obtained from a male patient whose main dentoskeletal cephalometric measurements closely matched the Eastman normal values (Mills, 1982). The Eastman normal value for lower anterior face height/total anterior face height (LAFH/TAFH) is 55 per cent with a standard deviation (SD) of 2 per cent (Figure 1). The film was traced by hand and the LAFH/TAFH of this original image was then increased or decreased, in 1 SD steps, up to 4 SDs from normal. This was undertaken by stretching or compressing the skeletal profile of the image equally at points A and B. The soft tissues were then redrawn in these regions. The soft tissue outlines above columella and below soft tissue pogonion were not altered and were identical for all images. This generated a series of nine images with LAFH/TAFH ranging from 47 to 63 per cent at equal intervals of 2 per cent. Only the vertical proportions of the images were altered, while the AP proportions (Class I) remained constant. The nine profiles were then converted to silhouette profile images. Examples of the profile images are shown in Figure 2.

The nine different profile images were printed onto a questionnaire. The sequence of profile images was randomly changed every 10th questionnaire. For each questionnaire a duplicate image of the second image of the sequence was also included to assess intra-examiner repeatability.

### Judges

Ninety-two first-year university social science students participated as judges in the study. Each judge was randomly allocated one of the printed profile sequences. The participants were asked to rate the attractiveness of each profile on a numerical scale of 1–10 with 1 representing very unattractive and 10 very attractive. For each image, the participants were also asked to indicate, using the response choices of yes or no, whether they would seek treatment if that image represented their own profile.

The questionnaire also requested other details regarding the participant's orthodontic history, including whether they had ever received orthodontic treatment, whether a family member had received treatment, and whether they thought



**Figure 1** Lower face vertical proportion was calculated using lower anterior face height (LAFH) as a proportion of total anterior face height (TAFH).



**Figure 2** Examples of profile images used in the study with the lower anterior face height to total anterior face height proportion recorded in percentage terms. The number of standard deviations from the Eastman normal value is indicated in parentheses.

they needed orthodontic treatment at the present time. The participants were also asked to rate the importance of having a nice smile (very unimportant, unimportant, important, very important) and the attractiveness of their own smile (very unattractive, unattractive, attractive, very attractive). Data analysis was performed using the Statistical Package for the Social Sciences (Version 11, SPSS Inc., Chicago, Illinois, USA). Repeatability was assessed using a paired *t*-test and an unweighted kappa statistic. Statistical analysis of attractiveness ratings and the subjects' desire to seek treatment was undertaken using paired *t*-tests and McNemar's test.

## Results

### Judges

The judges comprised 84 females (91 per cent) and eight males (9 per cent) who had a mean age of 21.8 years (range 18–39 years).

### Repeatability analysis

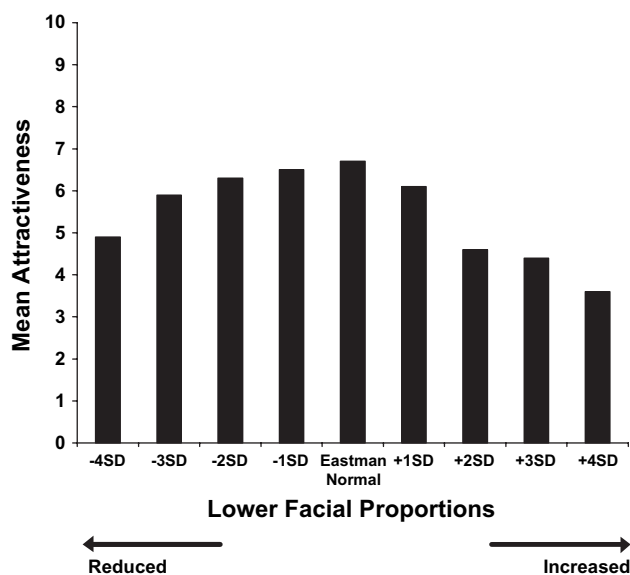
Possible scores ranged from 0 to 10. Repeatability was defined as the difference between two scores for each judge for identical images. The analysis revealed that on two assessments of the same image, the difference in scores was 2 points or less on 80 per cent of occasions, representing an acceptable level of agreement (Table 1). There was moderate intra-subject agreement regarding subjects' decisions on whether to seek treatment when the same image was viewed twice ( $\kappa = 0.5$ ).

### Attractiveness of profiles

The profile with the Eastman normal LAFH/TAFH was rated as the most attractive, with a mean score of 6.7 out of 10 (Figure 3). Attractiveness scores reduced as the lower face proportions diverged from the normal value. Images with reduced lower face proportions generally scored higher than those with increased lower face proportions. The results

**Table 1** Repeatability. Difference between the two scores for identical images for all 92 judges.

Difference between scores	Number of judges (%)	Cumulative %
0	19 (21)	21
1	38 (41)	62
2	17 (18)	80
3	10 (11)	91
4	7 (8)	99
5	0 (0)	99
6	1 (1)	100



**Figure 3** Attractiveness of profiles. The participants' mean attractiveness ratings for the Eastman normal lower facial proportion [55 per cent, standard deviation (SD) 2 per cent] and lower facial proportion, increased or decreased, in 1 SD steps, up to 4 SDs from normal.

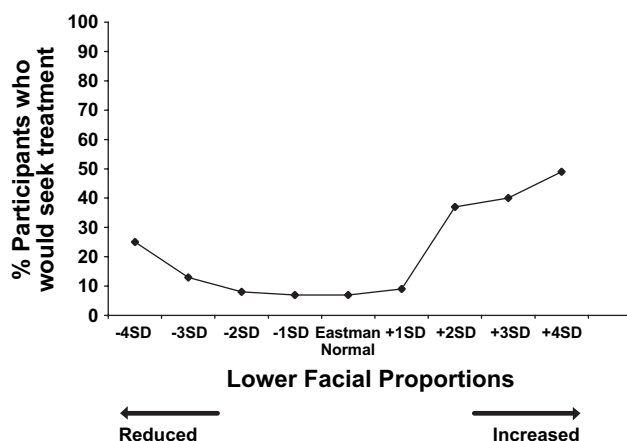
of matched paired *t*-tests demonstrated that participants rated the images with reduced lower face proportions as significantly more attractive than the corresponding images with increased lower face proportions (Table 2).

### Desire for treatment

Seven participants (8 per cent) failed to fully complete this section and were therefore excluded from this part of the analysis. Of the remaining 85 respondents with completed questionnaires, subjects were more likely to seek treatment as the vertical proportions diverged from the normal value (Figure 4). The greatest increase in desire to seek treatment was seen in the interval between +1 SD (LAFH/TAFH 57 per cent) and +2 SDs (LAFH/TAFH 59 per cent). At -4 SDs from the normal, 25 per cent of the sample would elect to have treatment, while 49 per cent would elect to have treatment at +4 SDs from the normal. Images with increased lower face proportions were more likely to influence subjects to seek treatment than the corresponding images with reduced lower face proportions. This was found to be statistically significant using McNemar's test, except for the images within 1 SD of the Eastman norm (Table 3).

**Table 2** Comparison of attractiveness ratings of images with reduced lower facial proportions [negative standard deviations (SDs)] and corresponding images with increased lower facial proportions (positive SDs).

Images compared	Mean attractiveness ratings (out of 10)	<i>P</i> (paired <i>t</i> -test)
-4 SD/+4 SD	4.9/3.6	<0.001
-3 SD/+3 SD	5.9/4.4	<0.001
-2 SD/+2 SD	6.3/4.6	<0.001
-1 SD/+1 SD	6.5/6.1	<0.05



**Figure 4** Desire to seek treatment. The percentage of participants who would seek treatment if their profile was represented by the Eastman normal lower facial proportion [55 per cent, standard deviation (SD) 2 per cent] and lower facial proportion, increased or decreased, in 1 SD steps, up to 4 SDs from normal.

**Table 3** Comparison of the percentage of participants who would seek treatment for images with reduced lower facial proportions [negative standard deviations (SDs)] and corresponding images with increased lower facial proportions (positive SDs).

Images compared	Participants who would seek treatment	<i>P</i> (McNemar's test)
-4 SD/+4 SD	25%/49%	<0.001
-3 SD/+3 SD	13%/40%	<0.001
-2 SD/+2 SD	8%/37%	<0.001
-1 SD/+1 SD	7%/9%	0.69 NS

### *Influence of other factors*

The participants were asked a number of questions regarding their orthodontic history. Forty-four participants (48 per cent) had previously received orthodontic treatment and 57 participants (63 per cent) had a family member who had received orthodontic treatment.

The participants were also asked about the importance of having a nice smile (very unimportant, unimportant, important or very important) and were also asked to rate the attractiveness of their own smile (very unattractive, unattractive, attractive or very attractive). The vast majority of the sample (83 per cent) thought it was important or very important to have a nice smile. The majority of respondents (77 per cent) rated their own smile as attractive or very attractive.

Linear regression analysis was used to determine whether any of the students' characteristics had influenced their scoring. The dependent variable was the point at which the respondents indicated that they would seek treatment (i.e. the mean of both the positive and negative side). Independent variables included age, gender, whether or not the participants or a family member had ever received orthodontic treatment, whether the participants felt they needed treatment now, the importance of having a nice smile, and the attractiveness of their own smile. Twelve of the 92 judges were over 24 years of age and the linear regression analysis indicated that they were less critical when rating the attractiveness of vertical skeletal discrepancy ( $P = 0.024$ ). However,  $R^2$  was only 0.05, indicating that the regression model including age only explained a very small amount (5 per cent) of the variation. It was also found that if a subject rated their own smile as attractive or very attractive, they were less likely to seek treatment for the image with LAFH/TAFH increased by 4 SDs ( $P = 0.033$ ). The other variables were not found to have any significant influence on the judges' ratings.

## **Discussion**

### *Cephalometric values used in this study*

Cephalometric normal values are commonly used for providing guidance to the clinician during diagnosis and

treatment planning and for monitoring the progress and outcome of treatment. The use of normal values was first suggested by Downs (1948), who based his normal values on measurements from a small group of subjects with untreated but excellent occlusions. Other investigations have also derived normal values from groups of individuals with clinically normal or acceptable occlusions and good facial appearance (Riedel, 1957; Taylor and Hitchcock, 1966; Peck and Peck, 1970; Broadbent *et al.*, 1975; Bishara, 1981; McNamara and Ellis, 1988). The current study was based around the Eastman normal value for LAFH/TAFH of 55 per cent, with a SD of 2 per cent (Mills, 1982). The Eastman normal values are widely used by UK orthodontists and their derivation by Ballard (1956) has been reviewed by MacAllister and Rock (1992) and Hamdan and Rock (2001). Ballard's calculated normal values agreed closely with those previously reported by Björk (1947).

### *Lower face vertical proportion*

The current study was designed to assess the influence of lower face height as a proportion of total face height on facial attractiveness rather than linear changes in lower face height. This was undertaken as clinicians generally look at the facial proportion rather than the lower face height in isolation (Hunt and Rudge, 1984). The actual value of the latter varies according to the overall size of an individual's face. It also varies with gender, as females are known to have generally smaller faces than males. The use of a proportion removes the problems associated with such natural variability and allows objective comparison with the Eastman values.

If the Eastman standard means and SDs for LAFH/TAFH are accepted as being representative of the Caucasian population and a normal distribution was followed, then the probability of a patient presenting with an LAFH/TAFH proportion outside the range used in this study would be extremely low. Although the mean Eastman standard values can be considered to be indicative of the population mean values, the SDs are likely to be smaller than those obtained from a true population survey. Nevertheless, patients with LAFH/TAFH proportions beyond the minimum and maximum used in this study are unlikely to be frequently encountered.

### *Influence of gender*

The original image used in the study was that of a male, while the judges were mainly female. The judges were recruited in such a way as to achieve a large number of raters, and it proved difficult to obtain an ideal gender balance. Even though linear regression analysis did not detect a gender influence on ratings, a cluster analysis was also carried out on the responses to the nine differing images. This indicated that nine of the 10 most idiosyncratic judges were in fact female. If the male judges were different



from their female counterparts, one would have expected more males to be idiosyncratic in their ratings. De Smit and Dermaut (1984) and Cochrane *et al.* (1997) also found no evidence to suggest that the gender of the images or judges had a significant influence.

#### *The most attractive vertical profile*

The current study found that the profile with the Eastman normal value for LAFH/TAFH of 55 per cent was considered by the lay judges to be the most attractive. This finding strongly supports the appropriateness of using the Eastman normal LAFH/TAFH proportion in clinical practice. The current findings also support Sergl *et al.* (1998), who suggested that the perception of beauty was associated with regularity of facial features as conveyed by measurement values located close to the mean. Edler (2001) also proposed that 'averageness' in facial appearance was an important factor in attractiveness.

In a study by Erbay and Caniklioglu (2002), orthodontists ranked photographs of Turkish adults and found the angle between sella-nasion and the mandibular plane (SN-MP angle) to be 2 degrees greater in the images rated as attractive than in those rated as unattractive. Although this difference was found to be statistically significant, it is unlikely to be clinically significant. That study assessed photographs of the 44 participants rather than profile silhouettes and in doing so other variables that may influence attractiveness were introduced, although the findings may also indicate some cultural differences in the perception of attractiveness.

#### *Changes in attractiveness with severity*

Attractiveness ratings decreased as the LAFH/TAFH proportions diverged from the Eastman norm of 55 per cent, but images with reduced lower face proportions were rated as significantly more attractive than the corresponding images with increased lower face proportions. This is in agreement with the findings of De Smit and Dermaut (1984) and Michiels and Sather (1994), although the reasons for this preference of reduced vertical proportions over increased vertical features are still unclear. It has been recognized that in children, attractiveness is related to the size of the eyes and the forehead relative to the rest of the face (Brooks and Hochberg, 1960). When the LAFH is reduced the forehead is relatively larger in relation to the rest of the face. Tallgren (1957) and Behrents (1985) reported an increase in skeletal face height with advancing age. Fedok (1996) documented that with age the soft tissues below the chin lose elasticity and drop creating the characteristic jowl that results in an apparent lengthening of the profile. Buss (1994) suggested that health and youth conveyed reproductive advantages and suggested that visual clues that supported these characteristics were

therefore deemed to be more attractive by potential mates. These factors may explain why the images with an increased lower face proportion were found to be less attractive in the current study.

#### *Changes in desire to seek treatment with severity*

Subjects were more likely to seek treatment as the vertical proportion diverged from the Eastman normal value. The greatest increase in desire to seek treatment was seen in the interval between +1 SD and +2 SDs above the Eastman normal values. This may indicate a threshold for correction, but it must also be borne in mind that even when the most severe images were viewed (increased or decreased by 4 SDs from the norm) the majority of subjects indicated that they would still not seek treatment if the image represented their own profile.

In a previous study that examined the attractiveness of varying degrees of mandibular AP discrepancy, as measured by SNB, over 70 per cent of subjects indicated that they would seek treatment when the discrepancy moved beyond 3 SDs from the mean (Johnston *et al.*, 2005). This may indicate that AP skeletal discrepancies are regarded by lay people as being more unattractive than vertical discrepancies.

Images with an increased lower facial proportion were statistically more likely to influence subjects to seek treatment than the corresponding images with reduced lower facial proportions, except for the images increased or decreased by just 1 SD. This reinforces the results of the attractiveness ratings in that lay people seem to find an increased lower face proportion more unattractive than a reduced lower face proportion.

#### *Influence of other variables*

The study found that older subjects were significantly less critical in rating the attractiveness of the images. This would appear to suggest that young people are more concerned with the attractiveness of facial appearance.

### **Conclusions**

1. The most attractive lower face proportion was the Eastman norm (LAFH/TAFH of 55 per cent).
2. Images with a reduced lower face proportion were considered to be more attractive than corresponding images with an increased lower face proportion.
3. Images with a reduced lower face proportion were less likely to be judged as needing treatment than corresponding images with an increased lower face proportion.
4. Older subjects were less critical when rating the attractiveness of vertical skeletal discrepancy.
5. The majority of subjects indicated that they would not seek treatment even for the more extreme vertical discrepancies.

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