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S Ferroni
A Borracchini
S Melacci
T Doldo

Author's affiliations:

Dr. Serena Ferroni

Resident Tuscan Dental School, University of Siena, Italy.

Dr. Andrea Borracchini

Associate Professor Tuscan Dental School, University of Siena, Italy.

Eng. Stefano Melacci

Researcher Department of Information Engineering, University of Siena, Italy.

Dr. Tiziana Doldo

Researcher Tuscan Dental School, University of Siena, Italy.

Correspondence to:

Dr. Serena Ferroni

Resident Tuscan Dental School, University of Siena, Italy.

Email id- serena.f.doc@hotmail.it

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Aesthetical Standards and New Technologies: a Comparison

Abstract

Aim: The aim of this work is to evaluate whether some facial components have a stronger impact than others on the perception of beauty and to determine whether classical aesthetical standards are still valid for the current face types.

Methods and materials: 58 students aged 18-30 years, 32 male and 26 female were analized. Face photos in a rest position were loaded on "Point.tool" software and some facial landmarks were loaded on "Venus" software to simulate aesthetical improvements. The square Pöch-Perseo mesh was used to develop our own mesh and each face was associated with a reference geometrical shape and a mesh. We carried out a quantitative and a qualitative evaluation of the face after and before the improvement of 75%. The data was subdivided into four categories.

Statistical analyses: "Kolmogorov-Smirnov", "Kruskal-Wallis" and "Man-Whitney U" tests were used. Data distribution in each group is not standard. There is a statistically significant difference in the four categories in each group.

Result: There are no facial components having a stronger impact on the beauty and attractiveness of a face. No geometrical shape prevails in our sample, although the oval shape is more represented than the others.

Conclusion: Classical beauty norms (oval shaped) can no longer be the only appropriate aesthetical reference for the variety of face types we examine in our daily practice.

Introduction

Ever since men and women have focused their attention on appearance, there has always been a need for a reference model. Be it mathematical, fractional or proportional, architectural, artistic, philosophical, religious, ethical or representational, this model has influenced our mind-set.

So far we have tried to unravel the features characterising an attractive face.

In the past, the main feature of a beautiful face was assumed to be symmetry. Later on proportions were supposed to be the yardstick for beauty. More recently, the ideal of face beauty was defined as an average of several face features.

Today there is an "ideal face" prototype mainly based on the knowledge inherited from ancient Greece: a universal North-Europide model of an oval shaped face[1,2,3,4].

This model is based on ethnical and geometrical features. However, it has shown its limits since there are attractive faces with different ethnic features and different geometrical shapes.

Perseo[5,6,7] introduced the concept of "face biotype". According to Perseo there are several ideal beauties, each one related to a basic face biotype from which individual facial aesthetics can be defined by applying the concept of ethnic, geometrical and personal variety as well. This way an aesthetical reference model that is not standardised and is almost individualised can be obtained to create a "macroscopically differential harmonisation" between the external and internal facial components. Aesthetics currently plays a fundamental role in social interpersonal relations, and professionals have to take this aspect of life into account.

We have asked ourselves whether the traditional model of facial aesthetics - despite its cultural changes throughout history - is still valid today. We have also asked ourselves whether we, as professionals, assess all the variables in our patients' faces when we examine them.

The treatment plan must be tailor-made to patients and their face biotypes and not the other way round. This way we will not provide the right standard treatment but the right treatment for their faces, because whatever makes the patients' appearance unique must be preserved.

An aesthetical reference model is essential, but what matters is to make sure that we are not guided by this model in our treatment plan, but the opposite.

This work evaluates a software programme ("Venus"[8]) that allows to improve facial aesthetics using the facial appearance of famous people who are considered attractive by their community as a reference. From observations made and results obtained it is clear that the software programme follows a customised approach to choose the reference facial aesthetics to achieve in the patient's face.

The aim of this work is to evaluate whether some facial components have a stronger impact than others on the perception of beauty (using "Venus" software designed to improve facial aesthetics) and to determine whether classical aesthetical standards are still valid for the current face types (on the basis of 15 geometrical forms used as reference by Perseo).

Methods and Materials

Our sample consists of 58 students aged 18-30 years attending the undergraduate course in General Dentistry and Prosthetic Dentistry at Siena University. They were enrolled in our study on a voluntary basis. The Male Group is composed of 32 students while the Female Group is composed of 26 students.

We took frontal pictures of their faces in a rest position. The photos were then loaded on "Point.tool"[9] software (Department of Information Engineering, University of Siena) and some facial landmarks were used to define facial features (Fig.1).

The photos with facial landmarks were then loaded on "Venus" software (Department of Information Engineering, University of Siena) to simulate aesthetical improvements of the mid- and lower face by 25-50-75-99%.

We used "Paint" (Paintbrush Version 2.1.1 (20101020) Copyright © 2007-2010 Soggy Waffles) to draw the contour for each face (Fig.2) and "Photoshop" (Adobe® Photoshop® CS3 per Windows® e Mac OS® Copyright © 2007 Adobe Systems Incorporated, 345 Park Avenue, San Jose, California 95110, USA) to create a mesh on the basis of the reference geometrical shape for each face (Fig.3).

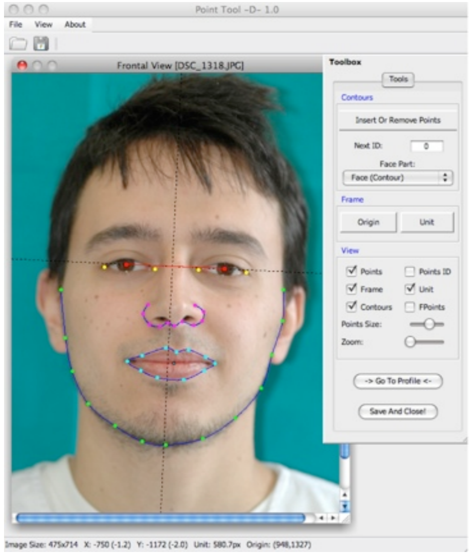


Fig.1- Facial landmarks.

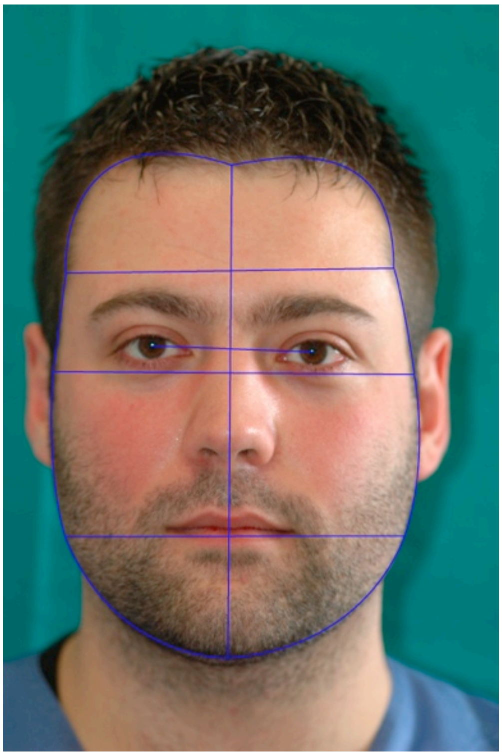


Fig.2- Face contour.

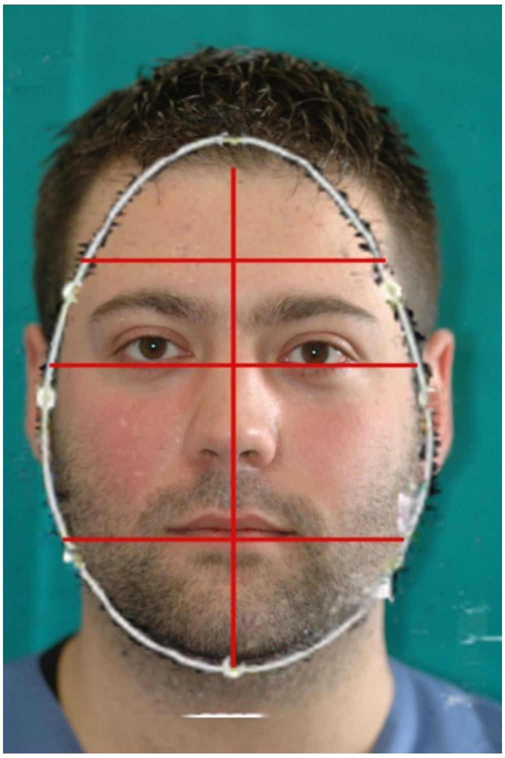


Fig.3- Geometrical shape.

We used the square Pöch-Perseo mesh as a reference to develop our own mesh (Fig.4).

The proportions of the upper, mid- and lower face take into account their transverse dimension as well as the total face height:

G1-G1 (upper face width) (rightG1-leftG1);
Zy-Zy (mid-face width) (rightZy-leftZy);
G0-G0 (lower face width) (rightG0-leftG0);
Tr-Gn (total face height) (rightGn-leftGn).
The physiognomic index (i.phys) is the relationship between face height (Tr-Gn) and bizygomatic width (Zy-Zy)

i.phys=(Tr-Gn)/(Zy-Zy)

The proportions of the facial thirds were calculated as follows:

Fig. 4- Square Pöch-Perseo mesh.

Zygoma-forehead index measuring the relationship between bifrontal width (G1-G1) and bizygomatic width (Zy-Zy)

i.front-zyg=(G1-G1)/(Zy-Zy)

Mandibular-zygomatic index measuring the relationship between bigonial width (G0-G0) and bizygomatic width (Zy-Zy)

i.mand-zyg=(G0-G0)/(Zy-Zy)

After measuring the "transverse proportions" of facial thirds and "Perseo physiognomic index", each face was associated with a reference geometrical shape and a mesh.
Geometrical shapes of the face contour as defined by Pöch-Perseo are classified as follows[7]:

Curvilinear geometry:
• Elliptic (G0-G0=G1-G1),
• Oval (G0-G0<G1-G1),
• Oval-reverse (G0-G0>G1-G1),
• Round (G0-G0=G1-G1).

Squared Geometry:
• Rectangular (G0-G0=G1-G1),
• Hexagonal-long (G0-G0=G1-G1),
• Pentagonal trapezoidal (G0-G0>G1-G1),
• Pentagonal trapezoidal-reverse (G0-G0<G1-G1),
• Pentagonal rectangular (G0-G0=G1-G1),
• Ectagonal (G0-G0>G1-G1) or (G0-G0<G1-G1)
or (G0-G0=G1-G1),

• Rhomboidal (G0-G0=G1-G1),
• Squared (G0-G0=G1-G1),
• Hexagonal-short (G0-G0=G1-G1),
• Trapezoidal (G0-G0>G1-G1),
• Trapezoidal-reverse (G0-G0<G1-G1).

Some examples are shown in Fig.5, Fig.6, Fig.7.

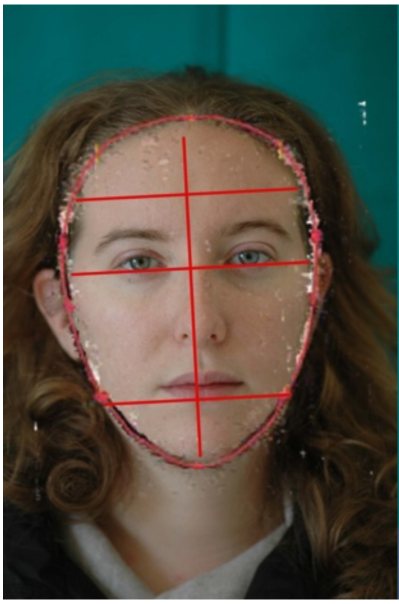


Fig.5- Oval shape.

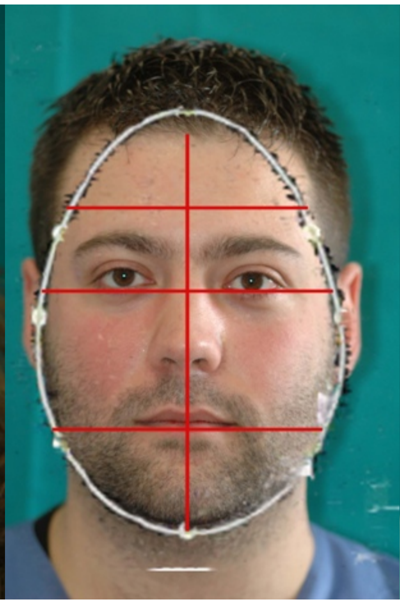


Fig.6- Oval-reverse shape.

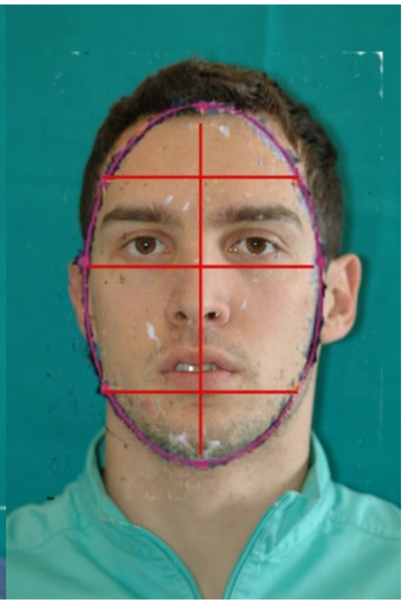


Fig.7- Elliptic shape.

“Point.tool” software automatically saves a file containing the coordinates (on the Cartesian axes x and y centered in between the eyes) of each reference point marked on the photo of the original face as well as the coordinates of the same reference point on the improved face which is repositioned equidistantly to the other points (Fig.8).

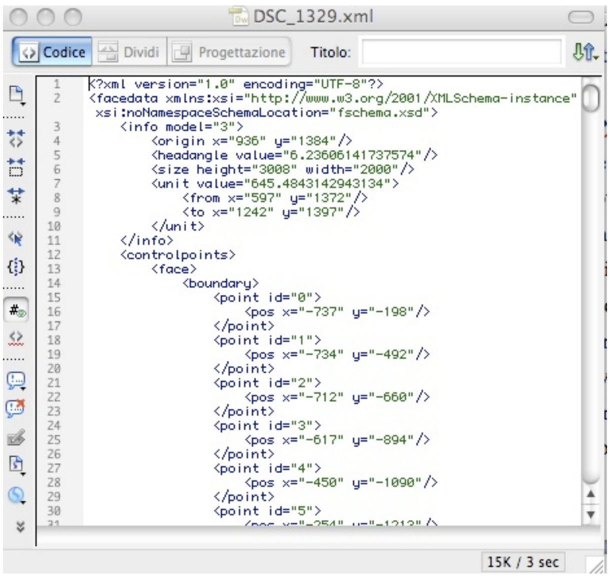
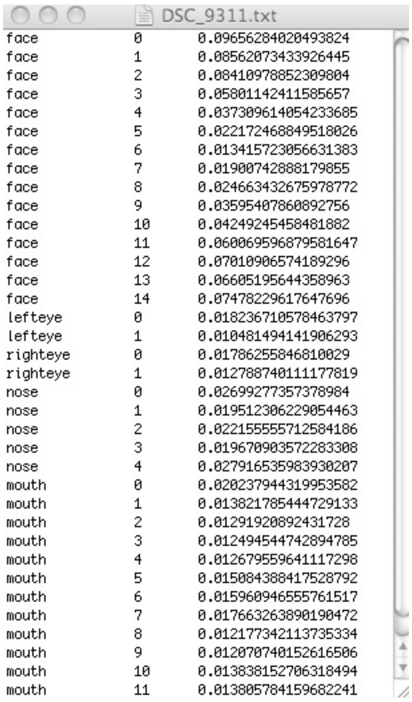


Fig.8- “Point.tool” software coordinates.

This process is aimed at standardising measurements and minimising the point positioning variable which is operator dependent.



DSC_9311.txt

face	0	0.09656284020493824
face	1	0.08562073433926445
face	2	0.08410978852309804
face	3	0.05801142411585657
face	4	0.037309614054233685
face	5	0.022172468849518026
face	6	0.013415723056631383
face	7	0.01900742888179855
face	8	0.024663432675978772
face	9	0.03595407860892756
face	10	0.04249245458481882
face	11	0.060069596879581647
face	12	0.07010906574189296
face	13	0.06605195644358963
face	14	0.07478229617647696
lefteye	0	0.018236710578463797
lefteye	1	0.010481494141906293
righteye	0	0.01786255846810029
righteye	1	0.012788740111177819
nose	0	0.02699277357378984
nose	1	0.019512306229054463
nose	2	0.022155555712584186
nose	3	0.019670903572283308
nose	4	0.027916535983930207
mouth	0	0.020237944319953582
mouth	1	0.013821785444729133
mouth	2	0.01291920892431728
mouth	3	0.012494544742894785
mouth	4	0.012679559641117298
mouth	5	0.015084388417528792
mouth	6	0.015960946555761517
mouth	7	0.017663263890190472
mouth	8	0.012177342113735334
mouth	9	0.012070740152616506
mouth	10	0.013838152706318494
mouth	11	0.013805784159682241

Fig.9- Sample group data.

After getting the numerical values of all points before and after face improvement for each student in the sample (we chose a 75% improvement), we calculated the Euclidean distance for each point - the distance between the point in the original face and the point in the improved face - on Cartesian axes (x and y). We then saved all data in a text file (Fig.9).

This way we obtained numbers with values providing a mathematical quantification of change based on the values of each point before and after face improvement for each individual in our sample.

With this procedure we carried out a quantitative evaluation of the points showing the biggest change in the whole sample.

The data we obtained was then subdivided into four categories - 1-Face, 2-Eyes, 3-Nose, 4-Mouth - and three groups: Male, Female and Total Sample. We finally performed a qualitative assessment of the changes made by "Venus" software by looking at the pictures of the faces before and after improvement. The photos were placed one beside (Fig.10a,b) the other using "Paint" software and then they were superimposed using "Photoshop" software (Fig.11).

Fig.10a,b- Side to side comparison.

Fig.11- Photoshop images. superimposition, before and after improvement.

When two pictures are superimposed it is not always possible to clearly identify all the changes made by "Venus" software, whereas when they are placed side by side the change becomes evident.

Statistical Analysis

We used “SPSS 17.0” (SPSS Inc. 233 South Wacker Drive, 11th Floor, Chicago, IL 60606-6412) for our statistical analysis. The distribution analysis was carried out applying “Kolmogorov-Smirnov” test ($p>0,001$). The differences between categories were checked with non-parametric tests. “Kruskal-Wallis” test ($p<0,001$) and “Man-Whitney U” test ($p<0,05$) were performed on the three groups (Total Sample, Female Group and Male Group). We also calculated the geometrical shape prevalence for our study sample.

Results

Data distribution in the Total Sample, Female and Male Groups is not standard.
There is a statistically significant difference in the four categories and in particular between category 1-Face and the other three ($p<0,05$). (Chart 1-2-3-4 , Table I-II-III)

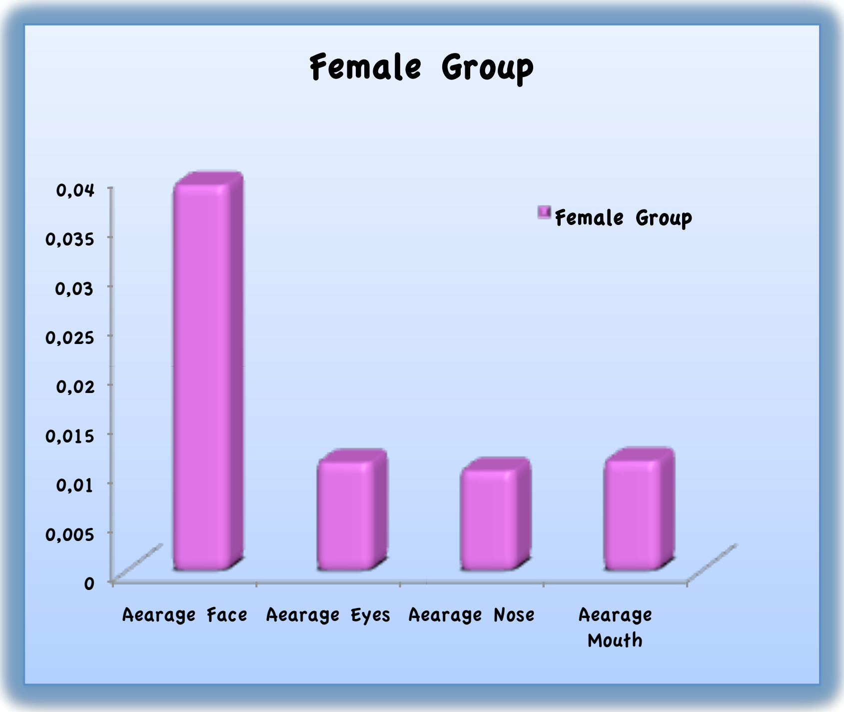


Chart 1. Female group.

Female Group	Average	Standard Dev.	
1-Face	0.039100534	0.020260274	a
2-Eyes	0.010939554	0.005494098	b
3-Nose	0.01010169	0.005460976	b
4-Mouth	0.011084097	0.0064896	b

Table I. Average and standard deviations in the four categories of our Female Group. The differences between categories are shown by a letter in the last column of the table ($p<0.05$).

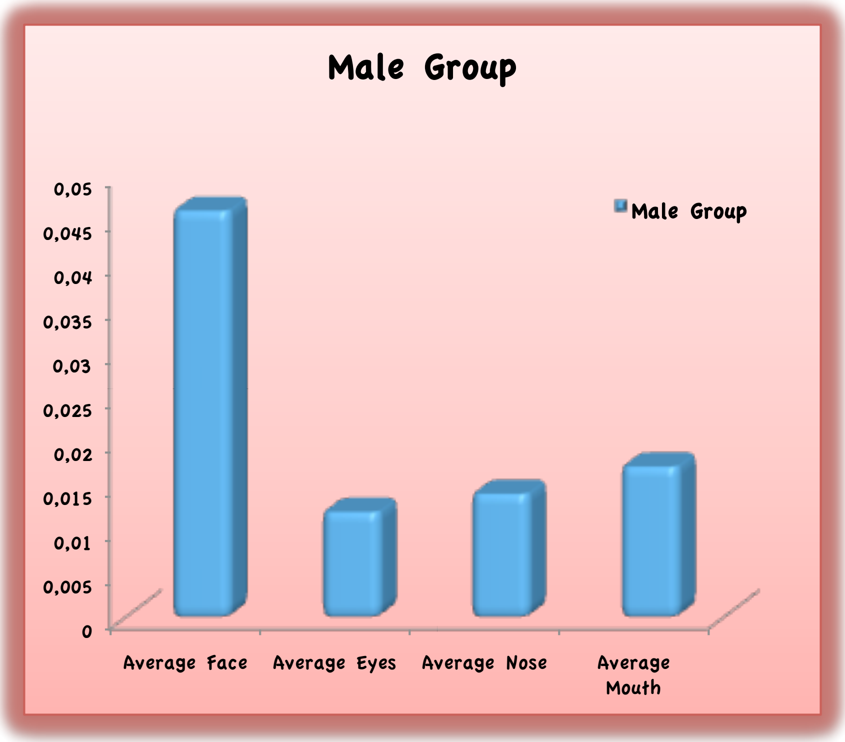


Chart 2. Male group.

Male Group	Average	Standard Dev.	
1-Face	0.046000625	0.025642259	a
2-Eyes	0.01189648	0.004877019	b
3-Nose	0.013947654	0.007566041	b
4-Mouth	0.017015131	0.009504616	b

Table II. Average and standard deviation in the four categories of our Male Group. The differences between categories are shown by a letter in the last column of the table ($p<0.05$).

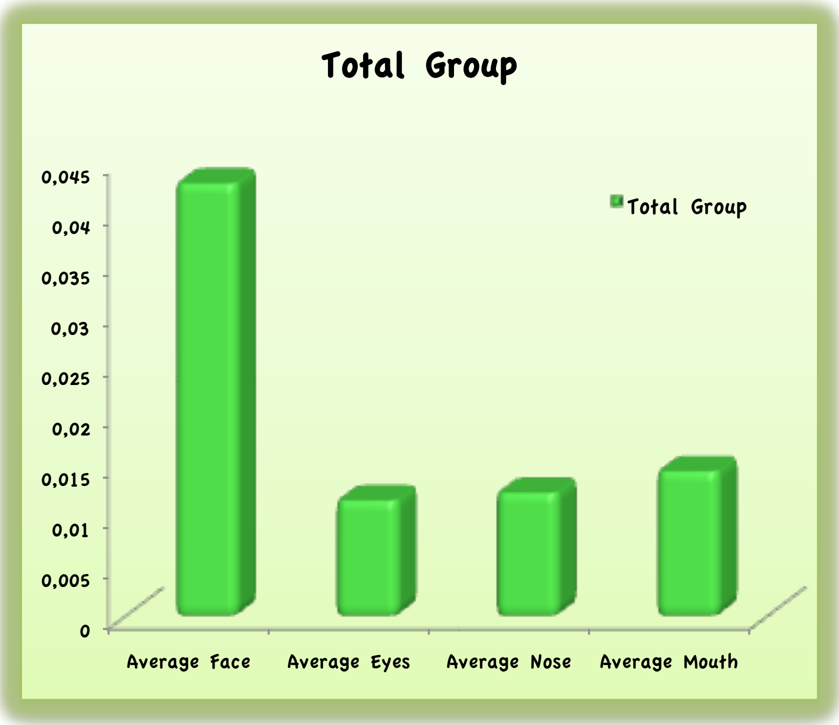


Chart 3. Total group.

Total Sample Group	Average	Standard Dev.	
1-Face	0.042907481	0.023621379	a
2-Eyes	0.011467513	0.005173335	b
3-Nose	0.012223601	0.006962561	b
4-Mouth	0.014356392	0.008794407	b

Table III. Average and standard deviation in the four categories of our Total Sample Group. The differences between categories are shown by a letter in the last column of the table ($p<0.05$).

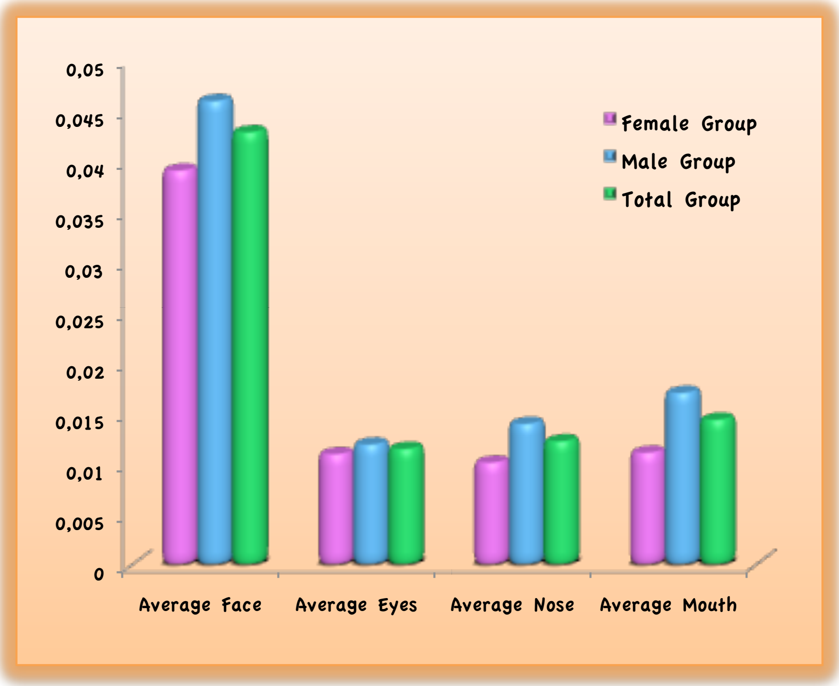


Chart 4. Comparison.

The results of our analysis of the geometrical shapes of the face contours in the three groups are the following:

- the majority of subjects in the Female Group has an ectagonal shaped face (Table IV, Chart 5);

	Female
Elliptic shape:	3
Oval shape:	6
Oval-reverse shape:	2
Round shape:	1
Rectangular shape:	0
Hexagonal-long shape:	0
Pentagonal trapezoidal shape:	0
Pentagonal trapezoidal-reverse shape:	6
Pentagonal rectangular shape:	0
Ectagonal shape:	7
Rhomboidal shape:	1
Squared shape:	0
Hexagonal-short shape:	0
Trapezoidal shape:	0
Trapezoidal-reverse shape:	0

Table IV. Geometrical shapes in the Female Group.

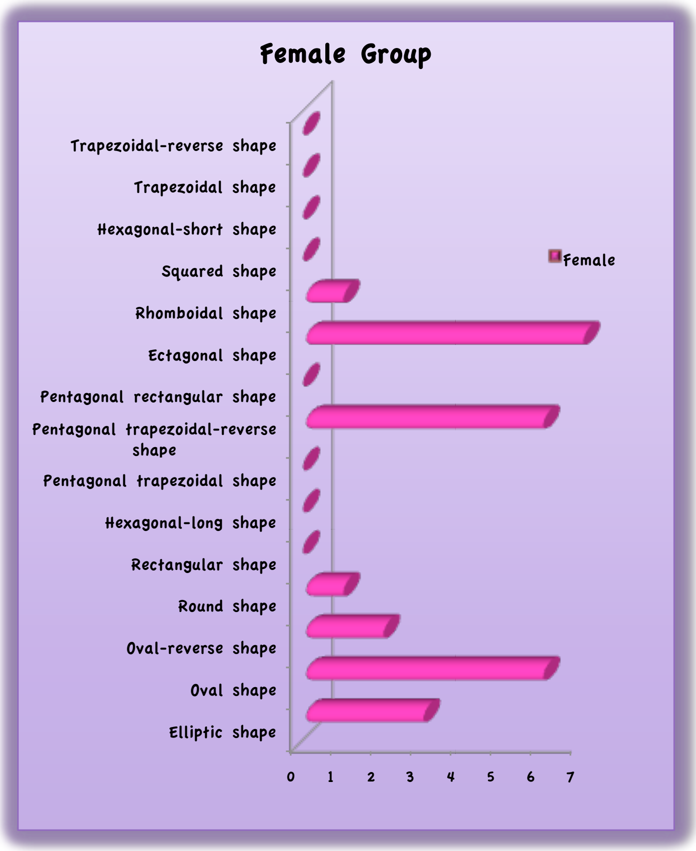


Chart 5. Female group.

- the majority of subjects in the Male Group has an oval shaped face (Table V, Chart 6);

	Male
Elliptic shape:	6
Oval shape:	9
Oval-reverse shape:	5
Round shape:	2
Rectangular shape:	0
Hexagonal-long shape:	0
Pentagonal trapezoidal shape:	4
Pentagonal trapezoidal-reverse shape:	1
Pentagonal rectangular shape:	1
Ectagonal shape:	2
Rhomboidal shape:	1
Squared shape:	0
Hexagonal-short shape:	1
Trapezoidal shape:	0
Trapezoidal-reverse shape:	0

Table V. Geometrical shapes in the Male Group.

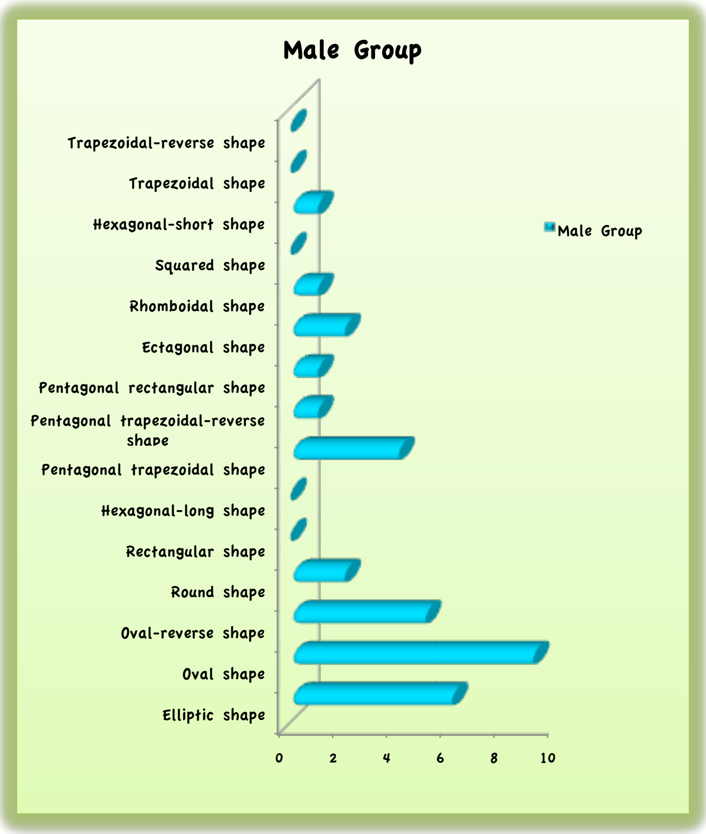


Chart 6. Male group.

- the majority of subjects in the Total Sample Group has an oval shaped face (Table VI, Chart 7-8)

	Total Sample
Elliptic shape:	9
Oval shape:	15
Oval-reverse shape:	7
Round shape:	3
Rectangular shape:	0
Hexagonal-long shape:	0
Pentagonal trapezoidal shape:	4
Pentagonal trapezoidal-reverse shape:	7
Pentagonal rectangular shape:	1
Ectagonal shape:	9
Rhomboidal shape:	2
Squared shape:	0
Hexagonal-short shape:	1
Trapezoidal shape:	0
Trapezoidal-reverse shape:	0

Table VI. Geometrical shapes in the "Total sample".

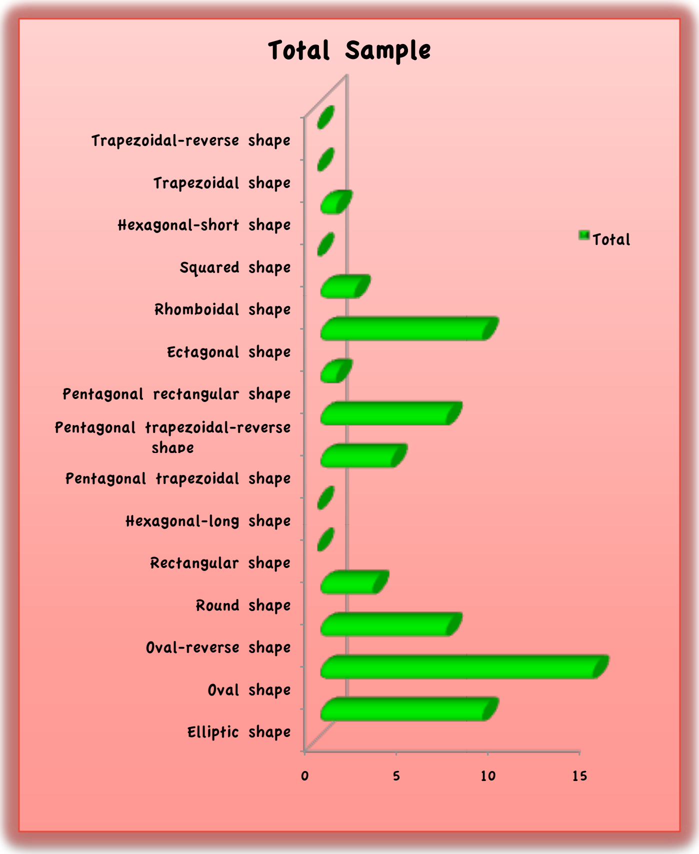


Chart 7. Total sample.

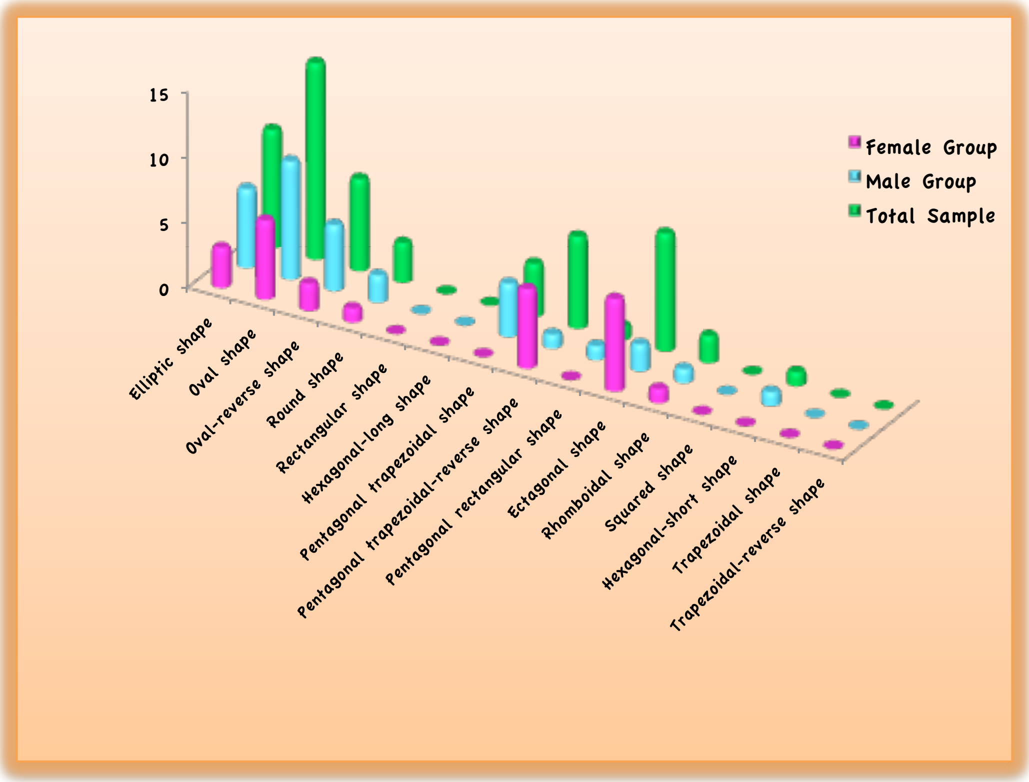


Chart 8. Comparison.

Conclusions

The results shown in tables I,II,III and charts 1,2,3,4 highlight a large amount of change in the Face category in the three Groups. This category includes all the points on the face contour after 75% aesthetical improvement made by "Venus" software.

Also a visual comparison of the faces shows a change in the face contour in the majority of our Total Sample Group.The reference points for the eyes, nose and mouth show a smaller amount of change because these components have a smaller size than the face contour and they are placed inside the facial complex.

The results of this study show that there are no facial components needing more changes than others in order to achieve conventional aesthetical standards. This study also highlights that there are no facial components having a stronger impact on the beauty and attractiveness of a face.

It was not possible to identify a standard model used by "Venus" software to improve facial aesthetics. "Venus" uses a different reference model for each individual according to the features of each person's face.

Geometrical reference shapes (Tables IV,V,VI Charts 5,6,7,8) have an uneven distribution in the Male and Female Groups. In the Female Group there is a higher number of ectagonal shaped faces (Table IV, Chart 5) and, differently from the Male Group, there is a more even distribution of shapes.

There is a higher number of oval shaped faces in the Male Group (Table V, Chart 6). It is worth noting, however, that this group was more represented in our sample and this had an

impact on the results for our Total Sample Group which shows a larger number of oval shaped faces(Table VI, Chart 7).
Our analysis of facial morphology shows that no geometrical shape prevails in our sample, although the oval shape is more represented than the others.
Differently from what we had expected, there is no prevalence of oval shaped faces in our sample. Only 15 out of 58 faces fall within the North-Europide oval model, with a smaller lower face, as defined by classical aesthetical norms.
Our analysis highlights that classical beauty norms - defining a face as oval shaped with a slender lower third - can no longer be the only appropriate aesthetical reference for the variety of face types we examine in our daily practice.

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