Golden Section and the Art of Painting

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1   Introduction

In mathematics, the *Golden Section* is a geometric proportion created by a point C on a segment of line AB when AC/AB=CB/AC, as shown in Fig. 1.

This ratio has the value Φ=0.618...

Since the times of antiquity many philosophers, artists and mathematicians have been preoccupied by the Golden Section, which the writers of the Renaissance have called the "Divine Proportion". The mathematician Lucas Pacioli has characterized the Golden Section as aesthetically satisfying and wrote on this theme the treaty "Divina Proportione". It is largely accepted that a rectangle having the sides in this ratio has special aesthetic qualities [1]. Moreover the Golden Section has been used as an ideal proportion on which the pattern of lines and shapes in the composition of a painting should be based. Taking

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this idea as a point of departure in this paper was done a statistical study on a series of paintings, belonging to various authors and from different periods to see how the Golden Section is applied in painting. The ratio between the sides of the paintings chosen by these painters is regarded as the most appropriate and beautiful proportion. Let's remark that $1/Phi$=1.618 is also related to the golden section by the relation $1/\Phi = \Phi + 1$.

2   Statistical study of paintings

It was done a statistical study on 565 works of art of different great painters: Bellini, Caravaggio, Cesanne[2], Goya, van Gogh, Delacroix, Pallady (Romanian painter), Rembrandt, Toulouse-Lautrec. It was calculated the ratio of the 2 dimensions of painting: the longer part to the shorter part of the painted rectangle. In Table 1 are given the average values and the errors of the average for the ratio of the sides for various paintings of the painters studied. The paintings considered in this statistics have been selected from the specified references, where the sides of the paintings have been indicated.

Assuming that all the painters under discussion enter in a statistics with equal weights, in Fig. 2a is shown the total distribution, for the number of paintings N= 565. The average value obtained for the ratio of the sides is

$$1.34 \pm 0.12.$$

This value, determined experimentally, is the result of the intuitive choice of great creators of art and is significsantly different from the value of the Golden Section $1/\Phi$=1.618, which is a theoretical ratio, obtained from an abstract, mathematical theory, which supposedly ought to impress on a painting a supreme harmony.

In Fig. 2b is illustrated the ratio L/l=1.34, lying on the maximum of the distribution, by the painting of Toulouse-Lautrec, "La Goulue entering at Moulin Rouge", dated 1891-1892, Museum of Modern Art from New York, having the dimensions 79.4 x 59 cm, and alongside this painting it is drawn a rectangle whose sides are in the Golden Section.

References

1. Peter B. Norton, Josph J. Esposito, The New Encyclopaedia Britannica, 15th Edition, 1995 2. Nicolas Pioch, WebMuseum Data Base

Tabelul 1. Average of the ratio of the sides of paintings, together with the error of the average for a number of paintings belonging to various painters

Painter	Number of paintings considered	Average L/l, error
Bellini (Venetian)	53	1.46 ±0.10
Caravaggio	37	1.32 ±0.15
Cezanne	100	1.26 ±0.27
Delacroix	42	1.32 ±0.17
Van Gogh	69	1.32 ±0.19
Goya	34	1.04 ±0.04
Pallady	127	1.30 ± 0.16
Rembrandt	39	1.33 ±0.14
Toulouse-Lautrec	64	1.36 ±0.12

A   C   B

Figure 1. Segment of line diveded by the point C
in the ratio of Golden Section Φ=0.618,
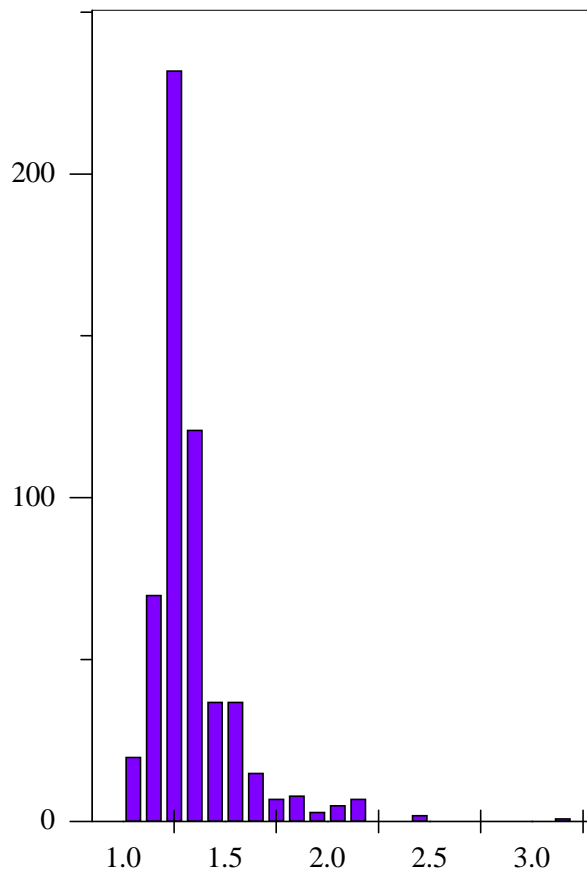where AC/AB=BC/AC

Fig. 2a. Distribution of the ratio L/l
of the dimensions of the paintings
N=565 paintings
R=1.34+0.12
Φ=1.618

The Layout of the graph has the height/width=1.618

Fig. 2b. Henri de Toulouse-Lautrec,
La Goulue entering at Moulin-Rouge,
Modern Art Museum from New York, 79.4 x 59

Φ=1.618

r=1.346