

A GLIMPSE OF OUR PAST

More Than A Neuroanatomical Representation in *The Creation of Adam* by Michelangelo Buonarroti, A Representation of the *Golden Ratio*

DEIVIS DE CAMPOS,^{1,2*} TAIS MALYSZ,³ JOÃO ANTONIO BONATTO-COSTA,^{1,4}
GERALDO PEREIRA JOTZ,³ LINO PINTO DE OLIVEIRA JUNIOR,^{1,4} AND
ANDREA OXLEY DA ROCHA¹

¹Departamento de Ciências Básicas da Saúde, Universidade Federal de Ciências da Saúde de Porto Alegre, 90050-170, Porto Alegre, RS, Brazil

²Departamento de Biologia e Farmácia, Universidade de Santa Cruz do Sul, 96815-900, Santa Cruz do Sul, RS, Brazil

³Departamento de Ciências Morfológicas, Instituto de Ciências Básicas da Saúde, Universidade Federal do Rio Grande do Sul, 90050-170, Porto Alegre, RS, Brazil

⁴Centro de Ciências da Saúde, Universidade do Vale do Rio dos Sinos, 93000-000, São Leopoldo, RS, Brazil

Michelangelo Buonarroti (1475–1564) was a master anatomist as well as an artistic genius. He dissected numerous cadavers and developed a profound understanding of human anatomy. Among his best-known artworks are the frescoes painted on the ceiling of the Sistine Chapel (1508–1512), in Rome. Currently, there is some debate over whether the frescoes merely represent the teachings of the Catholic Church at the time or if there are other meanings hidden in the images. In addition, there is speculation regarding the image of the brain embedded in the fresco known as "*The Creation of Adam*," which contains anatomic features of the midsagittal and lateral surfaces of the brain. Within this context, we report our use of Image Pro Plus Software 6.0 to demonstrate mathematical evidence that Michelangelo painted "*The Creation of Adam*" using the *Divine Proportion/Golden Ratio (GR)* (1.6). The *GR* is classically associated with greater structural efficiency and is found in biological structures and works of art by renowned artists. Thus, according to the evidence shown in this article, we can suppose that the beauty and harmony recognized in all Michelangelo's works may not be based solely on his knowledge of human anatomical proportions, but that the artist also probably knew anatomical structures that conform to the *GR* display greater structural efficiency. It is hoped that this report will at least stimulate further scientific and scholarly contributions to this fascinating topic, as the study of these works of art is

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*Correspondence to: Deivis de Campos, Ph.D., Departamento de Ciências Básicas da Saúde Laboratório de Anatomia Humana Universidade Federal de Ciências da Saúde de Porto Alegre–UFCSPA Avenida Sarmiento Leite 245, 90050-170, Porto Alegre, RS, Brazil. E-mail: dcampos@ufcspa.edu.br

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INTRODUCTION

For many years art, anatomy, and medicine have shared a close relationship, as demonstrated by Leonardo da Vinci's anatomical drawings and Andreas Vesalius' groundbreaking illustrated anatomical textbook from the 16th century (Bell and Evans, 2014). This close relationship between art and anatomy remains until today, since the use of illustrations still constitutes an essential element of learning anatomy (Calkins et al., 1999; Chosh, 2015).

In this context, the Renaissance was a period of extensive scientific and cultural production, which occurred between the fourteenth and sixteenth centuries. One of the exponents of this artistic period was the poet, architect, sculptor, and painter Michelangelo Buonarroti, who was born and lived in Italy between 1475 and 1564 (Strauss and Marzo-Ortega, 2002; Barreto and Oliveira, 2004; Lydiatt and Bucher, 2011).

Like many other Renaissance sculptors and painters (Eknoyan, 2000; Paluzzi et al., 2007), Michelangelo had a vast knowledge of anatomy, as confirmed by the perfection with which the human figure is represented in his works. This fact has led scholars from a variety of areas related to the study of human body to be interested in his art works and to considerable debate regarding their meaning, in relation to the historical, religious, and scientific aspects of each work (Strauss and Marzo-Ortega, 2002).

Among Michelangelo's many works, the frescoes painted on the ceiling of the Sistine Chapel in the Vatican are among the best known in the world. Michelangelo produced this work unaided between the years of 1508 and 1512, at the request of Pope Julius II. Regarding those frescos, there is some debate as to the extent to which they conform to the teachings of the Catholic Church at the time and the intention of the artist (Meshberger, 1990; Barreto and Oliveira, 2004). Among those frescoes the most widely known is probably "The Creation of Adam" fresco.

Meshberger (1990) noted how "The Creation of Adam" represented in the Sistine Chapel shows God surrounded by a drape that has the shape of what he believed to be the sagittal section of a human brain. According to Meshberger this was an encoded message from Michelangelo, signifying a belief that the "divine part" humans receive from God is the intellect, and not life—an interpretation strengthened, in his opinion, by the fact that Adam, moments before his creation, is already alive, with his eyes open and completely formed (Strauss and Marzo-Ortega, 2002).

In addition, Suk and Tamargo (2010) suggested that Michelangelo, a deeply religious man and an accomplished anatomist, intended to enhance the

meaning of this iconographically critical panel and possibly document his anatomic accomplishments by concealing this sophisticated neuroanatomical rendering within the image of God.

However, it is difficult to explain why Michelangelo might have been drawn to use such hidden symbolism in his work. Perhaps this was a playful parody of religious themes, unbeknown to the commissioners of the paintings, or maybe, less deliberately, the product of a new philosophical climate where a revitalized passion for life sciences was permeating all aspects of society, including art (Paluzzi et al., 2007).

In this context, an important mathematical relationship is found in countless works of art from the Renaissance period (Livio, 2002). The mathematical relationship known as the *Divine Proportion/Golden Ratio (GR)* ($\Phi = 1.6$) is the ratio between two lines of unequal length, where the ratio between the length of the shorter line and the longer line is the same as the ratio between length of the longer line and the sum of the lengths (Hutchison and Hutchison, 2010), as follows: $b/a = (a+b)/b = \Phi \approx 1.6$ (Fig. 1).

The *GR* is classically associated with greater structural efficiency (Livio, 2002) and has puzzled scientists for centuries due to its frequent occurrence in nature. Moreover, intriguing studies have shown the presence of *GR* in the organization of numerous natural structures, such as the shape of spiral galaxies (Livio, 2002; Hutchison and Hutchison, 2010), the *g*-Ratio of the nervous fibers (De Campos, 2014), spiral molluscan shells and plants (Newell et al., 2008). In addition, *GR* can be found not only in natural phenomena, but also in a variety of works by architects and designers, in famous musical compositions and the works of many other artists, including Leonardo da Vinci and Albrecht Durer (Livio, 2002).

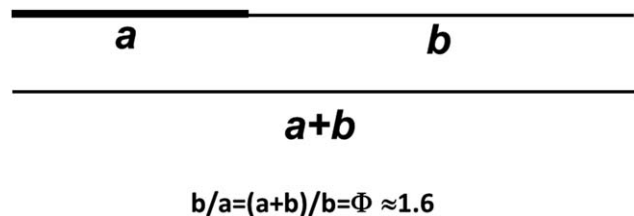


Fig. 1. The *Golden Ratio* (Φ) is a proportion of lengths of line segments, where the ratio between the lengths of the longer and shorter lines is equal to that of the ratio between the combined lengths of the two lines and the length of the longer line. Extracted from Hutchison and Hutchison, 2010.

In general, this ratio was used in these works to enhance what could be called their visual or auditory effectiveness. One of the properties contributing to that effectiveness is *proportion*—the size relationships of parts to one another and to the whole (Livio, 2002). The history of art shows that the pleasing esthetic qualities in all works of art seem to depend on the *GR*. Moreover, there seems to be a consensus among scholars in this area that the functional effectiveness of any structure depends on its approach to the number Φ (Livio, 2002).

However, while the beauty of Michelangelo's works is indisputable, there is no information in the literature regarding any association between his works and the *GR*. Thus, adopting a pioneering method, we decided to analyze one of Michelangelo's most famous works (*The Creation of Adam*) painted on the ceiling of the Sistine Chapel to see if there is any relationship with the *GR*.

OBSERVATION

Image Pro Plus Software 6.0 (Media Cybernetics, Silver Spring, MD, USA) was used to measure the distances between critical elements within the image of *The Creation of Adam* (Fig. 2), and extract the same

proportions of line segments used to obtain *GR*, as shown in Figure 1.

We chose the point precisely halfway between the pointing finger of the image of God and that of Adam as the division between the two lines because we assume it represents the point at which Adam receives the "divine part," i.e., the intellect, from God (Meshberger, 1990; Strauss and Marzo-Ortega, 2002).

Based on the actual dimensions of the image [2,800 mm × 5,700 mm] (Gardner and Kleiner, 2009) and in accordance with the rules established for obtaining the *GR* (Hutchison and Hutchison, 2010), it is apparent that by dividing the line $[a+b]$ asymmetrically, exactly at the point halfway between the two fingers, into two unequal portions, a ratio is maintained by which the larger segment (God) $[b]$ is to the smallest (Adam) $[a]$, is proportionally equal to what $[a+b]$ is to $[b]$; thus obtaining exactly $\Phi = 1.6$ (Fig. 2).

Hence, this observation might suggest that Michelangelo deliberately organized the characters within the image according to the *GR*. This can explain the whole context of the image, exactly as follows:

1. The fingers of God and Adam do not touch, because this is where there is an interruption, constituting the dividing line of the *GR*. Furthermore, God's finger would be pointing to

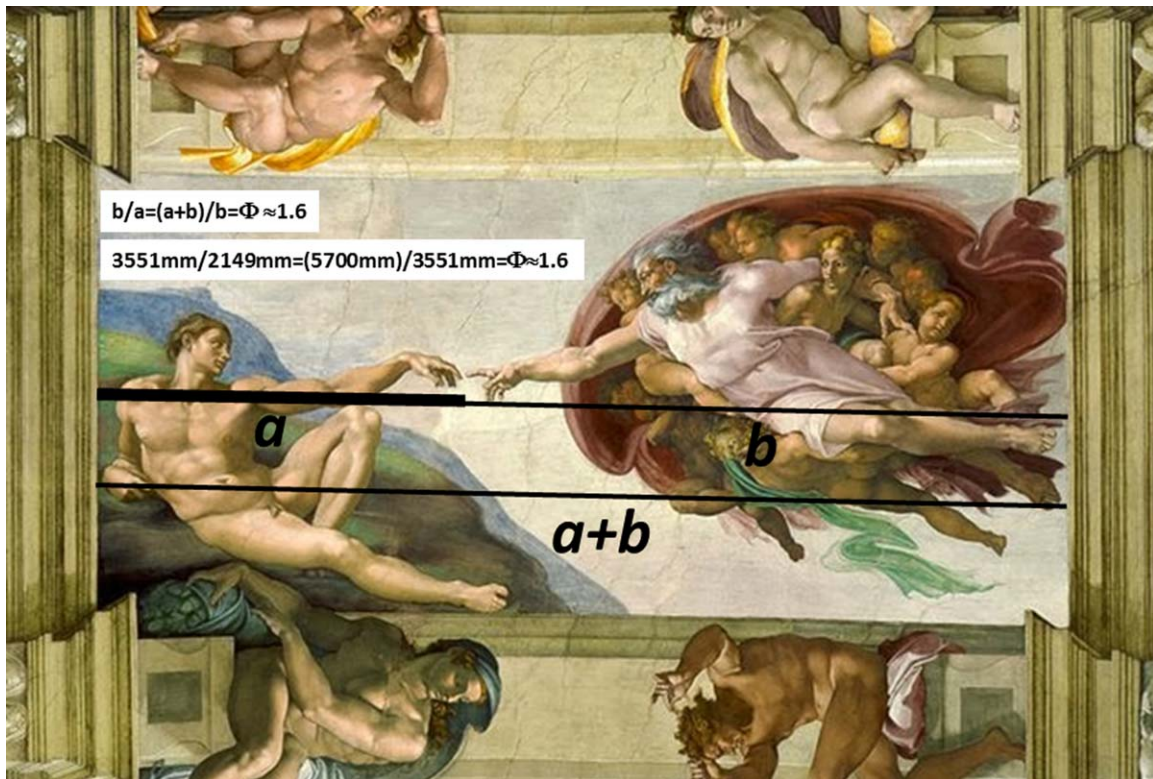


Fig. 2. *The Creation of Adam* fresco (1508–1512). Michelangelo Buonarroti. Extracted from Barreto and Oliveira, 2004. All measurements were taken with the aid of Image Pro Plus Software 6.0; Media Cybernetics, Silver

Spring, MD, USA. To calibrate the Image Pro Plus Software, the following commands were used: Measure/Calibration/Spatial. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]



Fig. 3. The ceiling of the Sistine Chapel (1508–1512). Michelangelo Buonarroti. Extracted from Barreto and Oliveira, 2004. As in Figure 2, all measurements were taken with the aid of Image Pro Plus Software 6.0; Media Cybernetics, Silver Spring, MD, USA. To calibrate the

something considered divine (*GR*) and so, in fact, Meshberger's Theory, which suggests Adam is receiving the "divine part," the intellect (Meshberger, 1990; Strauss and Marzo-Ortega, 2002), from God, would be correct.

2. God [*b*] is to Adam [*a*] as the sum of both [*a+b*] is to God [*b*]. In this case, God would represent the Heaven, while the Earth would be represented by Adam, where the sum of both would be the entire universe [*a+b*], which would also be to God [*b*]. In our view, this interpretation would be consistent with the context of the image (*Genesis 1: 26–27*) created by Michelangelo.

In addition, we also decided to apply the same analysis [$b/a = (a+b)/b = \Phi \approx 1.6$] (Hutchison and Hutchison, 2010) to see if there is any association in accordance with the *GR* between the fingers of God and Adam in relation to the other images that make up the ceiling of the Sistine Chapel (Fig. 3). The result of this analysis is astounding. As can be seen, the fingers of God and Adam are aligned with the other images on the Chapel's ceiling in accordance with the *GR*.

Therefore, the data presented here are compelling evidence that the *GR* ($\Phi = 1.6$), which is found in many biological structures and works of art by renowned artists (Livio, 2002; Newell et al., 2008; Hutchison and Hutchison, 2010; De Campos, 2014), did not go unnoticed by Michelangelo. Given this discovery, it is assumed that the beauty and harmony found in all the works of Michelangelo may not be based solely on his anatomical knowledge. We believe that in all probability, Michelangelo knew that anatomical structures incorporating the *GR* offer greater structural efficiency and, therefore, used the *GR* to enhance the aesthetic quality of his works.

Additionally, regardless of the debate on the representation or otherwise of the *GR* in "The Creation of Adam" by Buonarroti, there is no question regarding the beauty and artistic legacy left by the artist and its capacity to provoke questions until today. Moreover, the perfection with which the human figures are portrayed by the painter is also undeniable, which dem-

onstrates his profound knowledge of human anatomy. While, the opinions of those reading this article will certainly vary, we hope that this report will at least stimulate further scientific and scholarly contributions to this fascinating topic, since the in-depth study of these works of art are essential for understanding the history of Anatomy.

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