Research on the History: Development and Interaction of Human Proportion in East and West

Pei Lin *

Department of Marketing, Durham University, Durham, United Kingdom of Great Britain and Northern Ireland

* Corresponding Author Email: pei.lin@dunelm.org.uk

Abstract. The world-renowned Study of the proportions of the human body (also known as The Vitruvian Man) was drawn by Leonardo da Vinci around 1490. It depicts a male figure in two positions which are perfectly embedded in a circle and a square. Leonardo's use of mathematical description of human proportions, along with his own study and understanding of depicting the human body with a geometric method, is essential and profound on human proportions and many other subjects. This paper discusses the origins and development of the study of human proportions in history both in the West and East, as well as the purposes and the roles it played in art, religion, society, and culture. The object is to examine the differences and similarities in Eastern and Western ways and manifestations of depicting human proportions and provide more insight into the influence of cultural interaction of the human proportions theory. This study is of great significance to explore the development of human body proportions in China and the West.

Keywords: Human proportion; anthropometry; art history.

1. Introduction

Human proportions and measurement seemed to be a job for scientists or doctors nowadays. But they can be easily found in Renaissance artworks, such as The Vitruvian Man by Leonardo da Vinci, and the Measured figure study by Albrecht Dürer. These masterpieces became so famous they are admired all over the world. This paper tried to find the appearance and development of the human proportions theory both in the West and the East, the purposes of depicting a human figure, and the effect and influence of human proportions theories between different periods in the West and East. Whether there is an interaction between the human proportions theory in the West and East and their similarities and differences are also explored and discussed in the paper.

2. The History of the Theory of Human Proportions in the West

2.1. The human proportions before Renaissance

The definition of the theory of proportions is a system of establishing the mathematical relations between the various members of a living creature [1]. Panofsky has made a renowned study of methods of depicting human figures historically. The study of human proportions can trace back to the time of the Egyptian period. The Egyptians used equal squares to depict human beings and animals (see figure1). They designed a square and divided it into the same units. By fitting the figures into the square and the units, they do not consider if the joints of the human body and the lines are fitted. The intersection of the horizontal and vertical lines was used to decide where the ankle, knee, shoulders, and other joints lie in. The Egyptian proportions theory neglected the objective nor technical aspect and got rid of the border between anthropometry and the theory of construction.

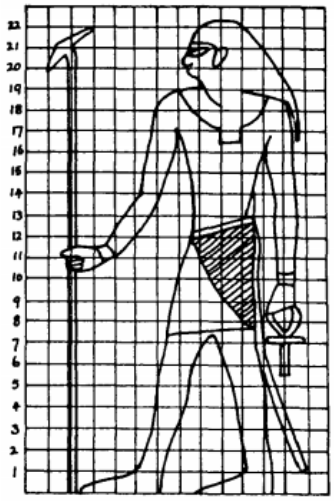

Fig 1. The "Later Canon" of Egyptian Art, after Travaux relatifs à la philologie et archéologie égyptiennes, XXVII, 905, p. 144.

Greek, influenced but freed from the Egyptian system of proportions, defined the idealized and heroic form by using a mathematical way (see figure2). Ancient Greek artists 'dissected' human figures into torso, limbs, hands, and feet. Then they tried to decide the relationship between each part and the whole. It was not mechanical but organic differentiation. They introduced and emphasized more on 'foreshortening' and visual observation. The inventions of 'contrapposto' and Polykleitos's theory influenced the Greek artists' aesthetic and their way of measuring and depicting human figures. Contrapposto is a more informal and fluid stance. Not like the immobile look of Egyptian art, it is relaxed which enabled the figures to appear to move. Forms became highly idealized. Polykleitos, regarded as the formulator of classical Greek anthropometry by Panofsky, wrote in his book (no longer existing) of proportions of the human figure that the body should be seven times of the head, and the beauty lies in the harmonic proportions between fingers, wrists, elbows, etc., [1-3]. His canon was a very early book on classical body types. Greek art can be seen as the initial period that brought mathematical measurements to show human proportions.

Fig 2. Polykleitos, Doryphoros (Spear Bearer), original: c.450-440 B.C.E., Roman marble copy of a Greek bronze original, National Archaeological Museum, Naples.

Roman architect Marcus Vitruvius Pollio and his Ten Books on Architecture (ca.25 BC) hold an important position on human proportions history which became a theoretical basis that affected many masters in later ages. In his book, he described human body measurements deliberately by starting with the finger's length and extending it to the length of the whole body. The description by

mathematical measurements and geometric figures of human body parts' proportions was an essential reference to artists like Alberti, Leonardo, Francesca, and Dürer. Later they built a more scientific and exhaustive way to draw human figures based on Vitruvius's measurement.

The medieval system can be divided into two different styles: The Byzantine and the Gothic. The length of the nose was used as a unit to measure all parts of the human body in the Byzantine system. Both the dimensions and the forms could be established geometric more, which leads to inaccurate objectivity [1]. While the Gothic system no longer measured the figure. The straight lines are used for guiding, not measuring. The intersection of the lines 'happened' to be the only movable joints of the human body. The organic human body was not considered anymore.

2.2. The Human Proportions in Renaissance

When in the Renaissance time, the proportion theory attracted artists tremendously, and it was called the divine proportion by Luca Pacioli. It is not only for making the artwork factual but also for the basis of natural beauty. Leone Battista Alberti and Leonardo da Vinci are said to be the most significant two talents who made the determinant steps to develop and surpass the standards of human proportions of medieval [1].

Before Alberti, people used absolute value (like Egyptian) or the proportion between body parts and height (like Vitruvius) to measure a human body. Alberti combined these two methods and improved them into an innovative measurement tool named 'Exempeda' (see figure 3) which could generate precise data of a three-dimensional human body [4].

Fig 3. Leon Battista Alberti, Finitorium, De Statua (On Sculpture), 1466.

Beauty is built in the relations on divine proportions of different parts, said Leonardo [5]. He engaged in finding a scientific way to measure the natural structure of the human body by using a compass and ruler. Based on empirical observation, he tried to define the human body in a more precise three-dimensional way.

From the Vitruvian Man (see figure 4), one of his most famous works, the human body can be formed a symmetrical geometric shape, such as the face can be constituted a square, diverge legs can be constituted an equilateral triangle, and the stretched limbs can form the perfect graphy-circle. Navel is the center of the circle while the genitals are the center of the square. The relationship between the circle's diameter and the side of the square is a consequence of the geometric relationship probably discovered by Euclid [6]. It also suggested that besides Vitruvius's text, some notes that Leonardo took in the drawing were probably from his learning of Alberti's De status [6]. Leonardo's scientific method and schematic attitude towards the study of human proportions accomplished The Vitruvian Man. It represents the method from not measuring to measuring mathematically, and from measuring in big and fewer units to small and numerous units. This is why Leonardo's iconic masterpiece is a turning point in human proportions history. Also, his geometrical study of the human

body influenced many other followers and great artists. The most accomplished yet unreachable is Albrecht Dürer.

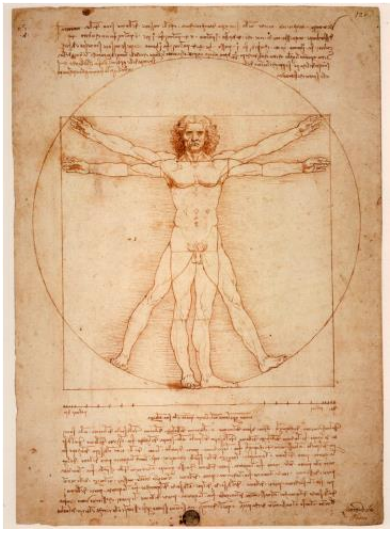

Fig 4. Leonardo da Vinci. Study of the Proportions of the Human Body (Vitruvian Man), stylus, pen and brown ink with light water color wash over metalpoint on paper, 345 × 246 mm, ca. 1490, Venice, Gallerie dell'Accademia, 228.

Under the influence of Vitruvius, Alberti, Leonardo, and Francesca, Dürer engaged more in scientific methodology rather than just pursuing the beauty and ideal proportion of the human body. Dürer wrote his well-known book Vier Bücher von menschlicher Proportion (1528) which also had profound value and influence on later generations. In his Vier Bücher von menschlicher Proportion (Four Books on Human Proportion), Dürer used Teiler and fraction to segment every part of the human body. The smallest unit (1/80 of the height) was to regulate the proportions of the height, width, and thickness of a body. In the second book of Four Books on Human Proportion, Dürer set a measuring scale as Alberti's Exempeda Method to divide the proportion:

Messstab 1messstab=10zall=100teil=300trumlein, same as 1/6, 1/60, 1/600, 1/1800 of height in fraction [7]. To exemplify the principle of this methodology, he drew an illustration in which the arms of the man tangent to a half circle (see figure 5).

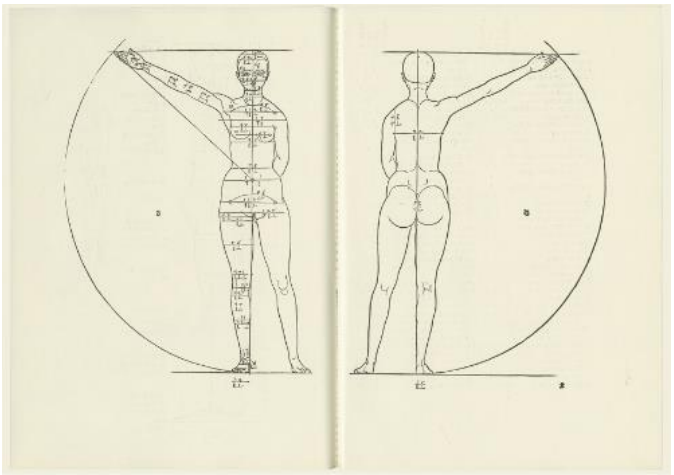

Fig 5. Albrecht Dürer. Measured figure study (male), From the Second Book of Vier Bücher von menschlicher Proportion. Nürnberg: Hieronymus Andreae, 1528, woodcut.

Apart from his study of a detailed full human body, Dürer also devoted an intense study of the parts of a body such as the head, hands, and feet. Unlike his fellows, Dürer no longer insisted on depicting the perfect ideal human body and started to display distinctive portraits of different appearances and personalities such as The Four Caricatured Profiles (see figure 6).

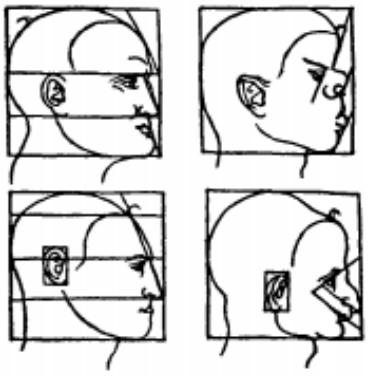

Fig 6. Albrecht Dürer, "The Four Caricatured Profiles" From the Third Book of Vier Bücher von menschlicher Proportion, Nuremberg, 1528.

Through plentiful demonstrations with more precise data on the human body, Dürer made the drawings more scientific, meticulous, and rigorous, which provided abundant guidelines for anthropometry to later generations. Panofsky believes Dürer's book is an unreachable rarity in the field of human proportions in the whole of history [1].

3. The History of the Theory of Human Proportions in the East

3.1. Human Proportions in Early India and China

The wide use and spread of human proportions in the ancient Eastern countries can be traced from the books and descriptions of how to draw Buddhist statues in India, given the prevalence of Buddhist culture in the East. Buddhist canons of proportions were originally from the Gupta Empire of India around the 4th century [8]. The measurement methods and styles of the depiction of the human body are taught to many Indians. It had been absorbed, and developed by Buddhists from Nepal, Gandhara, Kashmir, and central China, and devised according to their own aesthetic and art styles [9].

The book Pratima-mana-laksanam was believed to have been written before the 7th century and translated into Tibetan around the 7th century. It is one of the most important Indian classics of Buddhist art. It described the shape and size of different parts of the body and played an important part in aesthetic and drawing skills. Another book Buddha Body Image mainly discussed the measurement ratios of Shakyamuni Buddha. It showed the measurements with a Q&A between Sariputra and Shakyamuni "How to depict your image when you are away?" asked Sariputra, and "The vertical and horizontal are the same, as 120 fingers' length." answered Shakyamuni [10].

The image of Shakyamuni is a criterion of proportion theory in both Buddhism and Tibetan Buddhism. However, the application of this is by using Tibetan's local unit of measurement as a standard [11]. By using Tibetan barley, the length of a finger, a palm, and so on, it inherited the classical measurements and enriched the units which fitted the local anesthetic. It is worth noting that the image of Shakyamuni was used as the perfect criterion and regarded as the perfect human body in Buddhism.

Tibetan Thang-ka is the main form of art for spreading Buddhist doctrines that reflect objective reality and express the emotions of artists. It began in the time of the Tibetan Empire (between the beginning of the 7th century to the middle of the 9th century) and spread to Tibet sponsored by the imperial family. Thang-ka is a traditional Buddhist painting usually depicting a Buddhist deity, scene, or mandala on cotton or silk. It displays the beliefs, philosophies, and stories of Buddhism in the form of art and plays an important part in Tibetan culture [12].

The Indian measuring theory had a profound influence on the Buddhist proportions in Tibetan Thang-ka. It provided a criterion for depicting the image of the divine. It is reflected in the form of scripture as artists' painting basis. Artists should follow programmatic and theoretical regulations to depict Buddha statues. The main unit of measure of Tibetan Thang-ka is as below:

Table 1. The Conversion of Measurements in Thang-ka [11]

8 dusts	equals	1 tip of the hair
8 tips of the hair	equals	1 tadpole
8 tadpoles	equals	1 Sinapis alba L.
8 Sinapis alba L.	equals	1 Tibetan barley
8 Tibetan barley	equals	1 finger

It used scale to regulate the height in sitting and standing gestures, form, face, the gesture of hands, and also the seat of the Buddha. The most basic and important regulation is 'the standing position is 7 times of the head, the sitting position is 5 times of the head and the sitting with leg crossed position is 3.5 times of the head' (see figures 7 and 8). Finger width was also a typical unit used to regulate other parts of the body. 1 unit is 12 fingers wide. The temple to the middle of the brows is half of the unit. The middle of brows to throat=throat to middle of chest=chest to navel=navel to perineum=12 fingers width. Foot length=14 fingers, calf length=thigh length=25 fingers, etc. (see figures 7, 9,10).

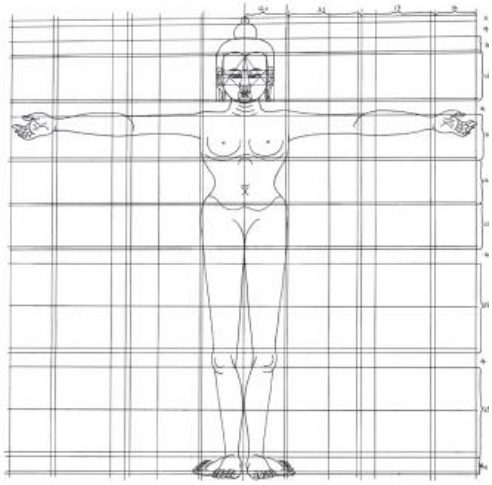

Fig 7. The measurements of Buddha's standing posture

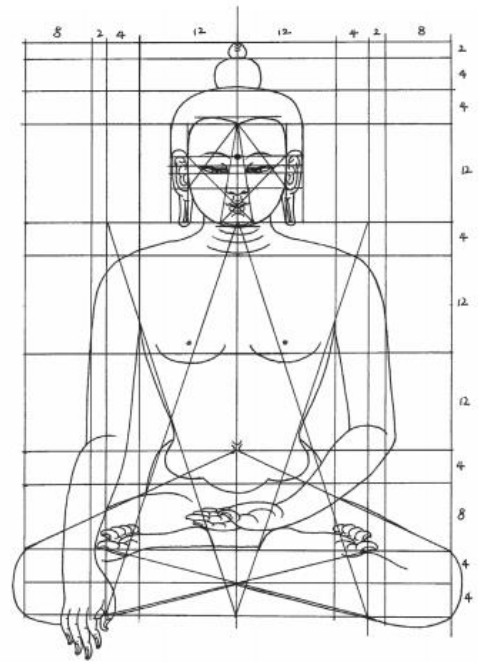

Fig 8. The measurements of Buddha's sitting posture with crossed legs

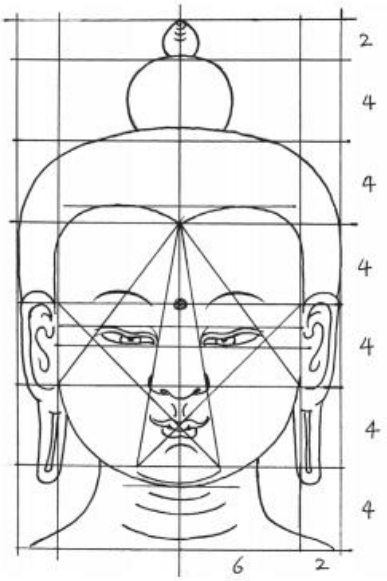

Fig 9. The measurements of Buddha's head

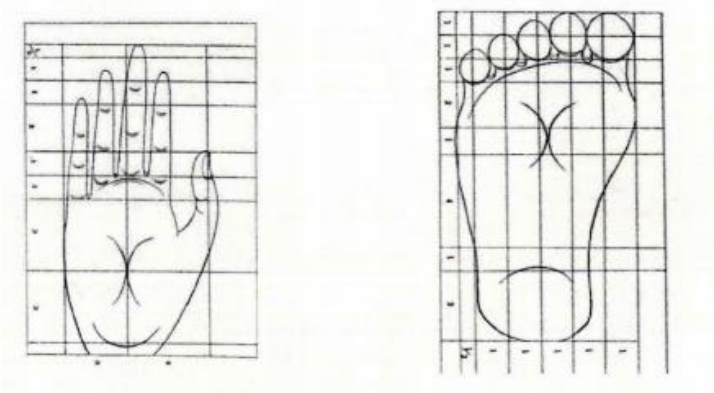

Fig 10. The measurements of Buddha's hand and foot

Although different schools of painting differed slightly in measuring units, the ultimate purpose of those artworks was to convey the verve and charm of the Buddha. Artists used the ideal and perfect proportions to concertize the statues. To express and visualize the power of God, the scripture of measurement comply with the theology. It was the embodiment of religious will, not just for depicting beauty.

3.2. The Human Proportions in Song and Ming Dynasty of China

From Song Dynasty, the portrait of emperors became very popular. Promoted by the empire, artists tried to seek truth from the facts without beautifying the figure. Yi Wang, the representative of the period, criticized the portrait of the figure sitting still like a clay sculpture which seemed prudish and rigid without vitality. It neither grasped the appearance of the figure nor the true temperament of his/her character. He claimed that it was important to make the figure in a relaxed state and revealed his/her original personality, characteristics, and temperament. The artist should grasp the moment, keep that in mind and finish the portrait soon after the state [13]. Take Yi Wang's The Portrait of Yang (see figure 11) as an example, it shows a retired official's detached and free state with a bamboo walking stick and a pine and stone by his side which represent honesty and prudence in Chinese culture. The Song artists emphasis more on paralogy, namely seeing through the inner world and the soul from a figure to depict him/her more genuinely [14].

Fig 11. Parts of The portrait of Yang, Yi Wang, Zan Ni, Ink on Paper, 277×868 mm,1363, The Palace Museum, Beijing

'Three parts and five eyes' (The face length are divided equally into three parts vertically, and five eyes' length horizontally, see figure 12) was raised developed by Yi Wang (1333-?), an artist in the Yuan Dynasty in his book The Formula of Portrait, and carried forward all through the periods of Chinese aesthetics in art. In his book Yi Wang wrote, the way to make a portrait painting is to see the face first, then make the vertical face into three parts evenly, the width of the head 5 times of eye's length evenly, and the jaw into the 3 times of mouth width evenly [15].

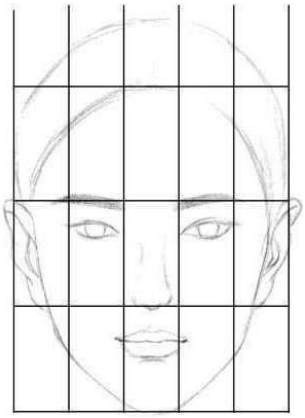

Fig 12. An example of 'Three parts and five eyes'

The 'Three parts and five eyes' criterion are still followed by Chinese artists nowadays when making a portrait painting. It divides the proportion of the face meticulously. 'Three parts' represents the face can be divided into three equal parts vertically: from the hairline to the middle of the eyebrow, from the middle of the eyebrow to the tip of the nose, and from the tip of the nose to the lower jaw. The three parts are isometric. The shape and the balance of each part are closely linked to a person's fortune, as believed by the ancient Chinese. The 'five eyes' means the face can be divided into five equal eyes' lengths horizontally: from the temple to the outer corner of the eye, from the outer to the inner corner of the eye, and between the two inner corners of the eye are five isometric parts. Also, the length of the jaw can be divided by the length of the two corners of the mouth into three equal parts.

Furthermore, Yi Wang also discussed closely different shapes of faces by classifying them into Chinese characters. They are determined by the size of people's foreheads, jaws, and facial features which are strongly defined. Therefore, Yi Wang emphasized the secret of making a perfect portrait painting is not only to follow the criterion but also to depict a person's facial features and expressions by actual observation [16]. Yi Wang's theory and his book summarized the way of making a portrait painting systematically. It became the most important criterion which passed on to later generations and made a textbook or a module for artists who taught their pupils and followers.

Lvqing Zhou, a dramatist in Ming Dynasty wrote in his book The Theory of Human Figure Painting, "The size of the hand is half of a man's face, the feet is 1.5 times longer than hands. The height of a man is depending on his face and the standing position is 7 times the head, and the sitting position is 5 times the head [17]." It can clearly be seen the criterion is the same at different times.

4. The Interaction and Differences of Human Proportions between West and East.

The origin of human proportion measurements is still a mystery, it appeared then divided into two systems which are the Egyptian and Indian systems. The Egyptian system affected Greece and Rome while the Indian system affected Hinduism and Buddhism, then spread to the north and south which lies in China, Nepal, Gandhara, et cetera [11]. It is believed by Chandra Wikramagamage that it must be a relationship between Egyptian, Greek, Roman, and Indian human proportion measurements [18].

It can be discussed in several aspects of the development and interaction of human proportions theory in the West and East: artists whether used measurements or not; what instrument they use when they measure; when mathematics, geometry, and other scientific disciplines were introduced in human proportions; the purposes they depict human in a proportional way.

Similarities:

What is common is people began to use body parts (such as finger width or length, palm length, and so on) to measure the whole size of a body both in the West (in ancient Greek times) and in the East (around the 4th century).

Other similarities lie in the purpose that artists depict human figures: Egyptian figure painting and sculpture used squares to frame the human body. Their art was to express the immortality of the divinities or people. Figure styles were depicted differently according to their ranks in the hierarchy, not recording the human and their proportions accurately. Just like Egyptians, Buddhism artists used stylized methods to express different dignified gods and goddesses. Although they began to measure the body, the main purpose was for artists to follow the steps and scheme to depict different Buddhas which fascinate and astonish people in a religious way.

Differences:

To depict the human body by using geometry and perspective was highly developed and emphasized particularly in Renaissance which was less mentioned in Eastern culture and countries. The Greeks laid the foundation of aesthetics in Eastern countries. Then humanity and the desire to explore and depict the perfect human body made Renaissance artists use more scientific ways such as Alberti's Exempeda, Leonardo's anatomy, and Dürer's endeavor to body part drawing. While at a similar time, artists in the East (Song Dynasty) emphasis more on expressing the inner world from the expression of the figure. So they accentuated to display subtle changes in facial expressions (although their colleagues in the West also took a lot of effort to do so), not the perfect proportions of the whole body. Therefore, the tools their Western counterparts invented or used for measuring and depicting the human body such as measuring instruments, scales, rulers, and so on were seldom found used by the Eastern artist.

5. Conclusion

Human proportions theory had been turning from not measuring to measuring mathematically, and from measuring in big and fewer units to small and numerous units. The Egyptian human proportions method had been constructional the classical Greek theory had been an initial period that introduced mathematical measurements to show human proportions which can be concluded as anthropometric. The Romans applied more detailed measurements to human proportions which had become such prominent references and the starting point of the research of the perfect human body to the Renaissance masters. The Byzantine theory in the Middle Ages considered ratio, but the Gothic had a schematic based on the principle of planimetric schematization. While the Renaissance combined

the Greek and medieval human proportion theory with the golden section, perfect ratio and the ideal proportions bear in artists' minds. It is the peak of the development of human proportions theory which affected numerous people and disciplines in later generations.

While in the east, the 7th century India has already brought the conception of human proportions by measuring and standardizing Buddha's body in a way to worship. It had such an influence on areas in Nepal, Gandhara, Kashmir, and China. Rather than beauty, the different proportions are used to show artists' divine skill and artistry. The most important is to follow the criterion and the scale, not the timeliness and the effectiveness. Making the delicate work is a way of practicing and meditating, and worshiping the god and goddess. The measuring system in Buddhism is set for representing the image of divinity and following the theology, and to show the supernatural and mighty power of the god and goddess. From the Song Dynasty of China, artists began to measure and set standards of facial features and the height of a figure, but more emphasis on the facial expression which reflected the figure's psychological activity.

Although there are huge differences in the beginning and development of human proportions in the West and East, the intercultural and human wisdom made artists in both the West and East went to the same way to measure the human body. Such as: Egyptian and Indian draw human bodies for the same purpose of worship, preaching, and ritual culture and beliefs based on their religious belief. Also, Greek and Indians all began to use small body parts to measure the whole body. Furthermore, artists in both Renaissance and Song Dynasty in China devoted themselves to presenting the subtle facial expressions reflected by the inner world and the temperament of the character meticulously.

The culture is different, but it belongs to human civilization. From the perspective of the entire civilization, eastern and western cultural interaction make the art and expressiveness similar which are all treasures to the whole world.

References

[1] Panofsky, Erwin. Meaning in the Visual Arts: Papers in and on Art History. Garden City: Doubleday, 1955.

[2] Tobin, Richard. The Canon of Polykleitos. American Journal of Archaeology 79, 1975(4): 307–21.

[3] Vitruvius.The Ten Books on Architecture. London: Harvard University Press, Cambridge,1914.

[4] Haoxuan Lin.The Preliminary inquiry of Alberti's human proportions theory. Art Observation, 2019(290):83-88.

[5] Martin. Edited and translated. Leonardo on Painting. New Haven: Yale University Press, 1989.

[6] Murtinho, Vitor. Leonardo's Vitruvian Man Drawing: A New Interpretation Looking at Leonardo's Geometric Constructions. Nexus Network Journal 17, 2015(2): 507–24.

[7] Gallucci, Giovanni Paolo, and James Hutson. Gallucci's commentary on Dürer's four books on human proportion: Renaissance proportion theory. Open Book Publishers, 2020.

[8] Suonan Dongzhi. Brief description of the statue measurement of Thang-ka art. Chinese Minzu Art, 2020(4):58-63.

[9] Luyi Sun. The research on the formalization of the Buddha Statue from the effect of Buddha image measurement. Luxun Academy of Fine Arts, 2019.

[10] Xiawu Duanzhi. The measurement proportion theory of Tibetan Painting and its foreign research status review.Journal of Inner Mongolia Arts University 3, 2020(17):157-163.

[11] Xiawu Duanzhi. The theoretical research of Thang-ka. Minzu University of China, 2017.

[12] Siqi Gao. The Construction and Deconstruction of Tangka's Sacred Nature-Tangka Attribute Research from the Perspective of intangible culture heritage.Chinese National Academy of Arts, 2019.

[13] Lianpeng He. The portrait painting research and Xie Xiang Mi Jue research. Shanxi Normal University, 2014.

[14] Yi Zhi.The portrait painting and tactics of Yi Wang. Journal of Hubei Academy of Fine Arts, 2017(4): 121-123.

[15] Yi Wang. The Formula of Portrait. Heilongjiang: Northern Literature and Art Publishing House.2021.

[16] Bingying Li. The theoretical research of Yi Wang's Portrait paintings in the Yuan Dynasty. Arts Circle, 2018(5): 84-85.

[17] Yiping Yan Edited. Lvqing Zhou. Theory of Human Figure Painting.Taipei: Yee Wen Publishing Co., Ltd.,1966.

[18] Chandra Wikramagamage. Principles of Buddhist Iconology. Academy of Sri Lankan Culture, 1997.