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A Study of Terracotta Warrior Proportions Based on Grid Division

Wang, Chaoran*[a]; Hann, Michael

[a] Lancaster University, Lancaster, UK
[b] University of Leeds, Leeds, UK
* chaoran.wang@lancaster.ac.uk

The so-called 'Terracotta Army' or 'Terracotta Warriors' is a collection of life-sized clay figures excavated in China in 1970s. The main function of this army was to guard the after-life of the first emperor of China. Archaeological evidence shows that the manufacture of the warriors involved a degree of mass production; therefore, it is believed that various standards of proportions can be detected in the terracotta figures. It is well known that grid systems played an important role in dividing the human body geometrically to provide proportions. Application of square grid systems (or cannons of proportion) have been found in ancient Egyptian drawings, ancient Greek sculptures as well as Renaissance statues. This paper reports on the study of 35 of the terracotta standing human figures selected from the 'The Pit 1 excavation report', and explores a 15-grid proportion system which may have been used by ancient Chinese crafts people when producing Terracotta Warriors.

Keywords: grids, proportion, Terracotta Warriors

1 Introduction

The terracotta army was discovered in Xi'an, China in 1974 (Geddes, 1984, p.5). The site can be dated back to 247 B.C.E. (Liu, Pagán and Liu, 2011, p.353) and was constructed to guard the after-life of the first emperor of China.

It is well-known that two-dimensional grids were used as guidelines to solve layout problems in various spheres of design. It has been shown that square grids were used in ancient Egyptian paintings (Weingarten, 2000, p.104; Iversen, 1968, p.217), that they underlie ancient Greek sculptures (Weingarten, 2000, p.106) and were used also in Assyrian reliefs (Robins, 1990, p.117) to provide proportional reference points for parts of the human body. This paper reviews the common types of proportional systems used (generally square grids of given proportions), as well as how different types of system divided the human body differently. A 15-grid system was developed (based initially on the division of the body by three) in order to study the terracotta warrior standing figure proportions (as this was found to be the most convenient means of accommodating the figures examined).

Attention is focused first on providing background information and on giving an explanation of the sampling methods used for selecting the terracotta figures. Then common types of cannons used elsewhere, and how they provided proportional division of human figures, are

reviewed, followed by an explanation of the analytical methods used for the terracotta warrior study reported here.

2 Terracotta army's background information

This section provides a range of background information relating to the terracotta army including commentary on the source of data and the process of making terracotta warriors.

The so-called terracotta army was discovered in Lintong, a country district in the east of Xi'an, China in 1974 (Geddes, 1984, p.5). As noted in the introduction, the site can be dated back to 247 B.C.E. (Liu, Pagán and Liu, 2011, p.353) and was constructed to guard the after-life of the first emperor of China. Approximately 8,000 individual soldier-type clay figures, invariably referred to as 'warriors' (Geddes, 1984, p.5; Liu Pagán and Liu, 2011, p.352), 130 chariots and 670 horse figures (Liu Pagán and Liu, 2011, p.353) have been excavated so far, and this is believed to be only a small proportion of the total number of terracotta figures yet to be excavated (Liu Pagán and Liu, 2011, p.353).

From 1974 to 1976, three pits were found and numbered Pit 1, Pit 2 and Pit 3. These are located close to each other and occupy a total area of around 20,000 square metres (Zhao, 1988, p.1). The relative position of each (with a few further sites) is shown in Figure 1.

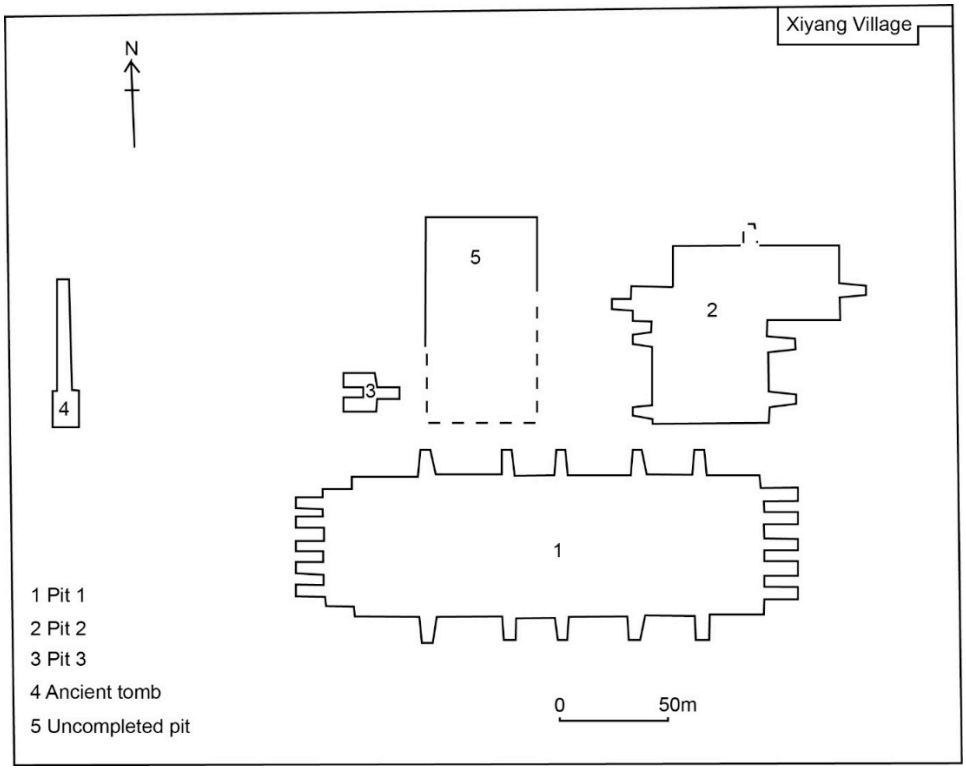


Figure 1. Positions of Pit 1, Pit 2 and Pit 3. Source: Re-drawn from Zhao, 1988, p.5.

The excavation of pit 1, (which occupies over 14,000 square metres) started in May 1978 (Zhao, 1988, p.1). The whole pit was divided into 27 squares (Figure 2). From 1979 to 1981, five squares against the east end of the pit were excavated. They are marked 1, 2, 10, 19 and 20, and illustrated in shaded form in Figure 2 (after, Zhao, 1988, p.9). Within these five sections, 1087 soldier figures (687 with armour and 400 without), 8 chariots and 32 horse figures were excavated (Zhao, 1988, p.10). By the year 1984, a further 28 terracotta (or pottery) horses and 714 warriors of different ranks had been uncovered (Zhao, 1988, p.10).

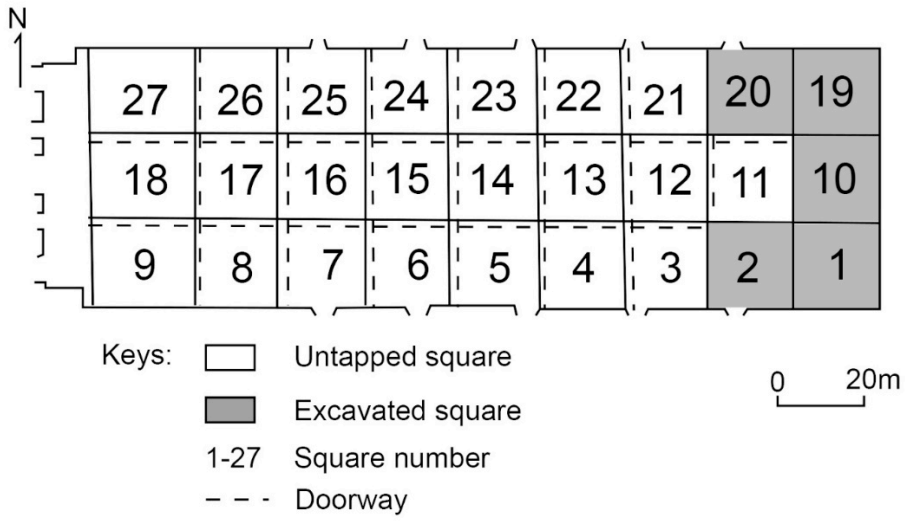


Figure 2. Locations of squares in pit 1 excavation. Source: Re-drawn from Zhao, 1988, p.10.

All illustrations of the figures and the measurements are based on the excavation report of the five squares (1, 2, 10, 19 and 20) in Pit 1.

The uniforms of soldiers and officers have no significant difference. The difference between the type of arms and ranks depend on the difference in the types of armour. Figure 3 shows the types of armour (Fu, 1985, p.10; Zhao, 1988, p.142).

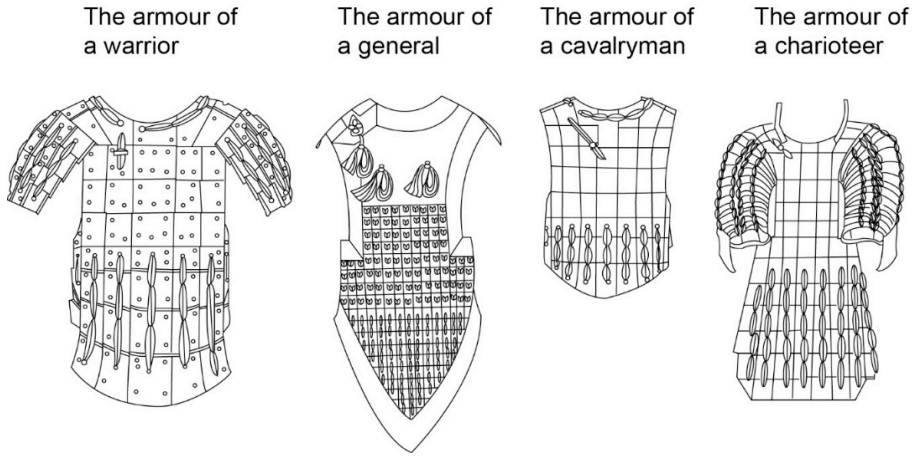


Figure 3. Types of armour. Source: Re-drawn from Fu, 1985, p.10.

Famously, each terracotta figure appears to be different and each may well be an individual portrait of an actual soldier (Portal, 2007, p.21) but this is not known with any certainty. However, to the contrary, archaeological evidence shows that the manufacture of the warriors involved a degree of mass production as a limited repertoire of body parts were found joined together in different combinations (Portal, 2007, p.21), with detailed work added by hand subsequently (Portal, 2007, p.21).

The heads and hands of the terracotta warriors were made separately, and then they were added to the torsos (Zhao, 1988, p.503). Similar to the body producing process, the rough shape of heads and hands were made with moulds first, and then individual details were sculptured on the top (Zhao, 1988, p.504). The variety of face shapes and the variety of

hand sizes and gestures suggests that there were several different types of moulds used to produce rough shapes during the manufacturing process (Zhao, 1988, p.499).

3 The selection of cases to be analysed

Robins mentioned that 'the whole figure must be preserved if it is to be used for grid analysis'; photographs have to 'be taken straight on without distortion'(Robins, 1990, p.108). Based on this view, 35 standing warrior figures illustrated in Zhao's 1988 report 'The Pits of Terracotta Warriors and Horses of Qin Shihuang Mausoleum - An Excavation of No. 1 Pit' (the Pit 1 excavation report) were selected.

Compared to the photographs presented in the report, the line illustrations of the warrior figures appeared to have less distortion. Also, it should be noted that only illustrations showing a front view were used. Kneeling figures were excluded from the study. So, using the Pit 1 excavation report as the source, all of the standing figure line illustrations, presented in the front view, were selected as samples for further proportion study.

4 Methods

Grid systems play an important role in dividing the human body geometrically since ancient times. Square grid systems (or cannons of proportion) have been found in ancient Egyptian drawings (Robins, 1994, p.73), ancient Greek sculptures (Weingarten, 2000, p.103) as well as Renaissance statues (Zenas, 1976). These grid systems allow for the standardization of proportions, and permit artists to place key points of the human body on particular grid lines in both horizontal and vertical directions. However, considerations relating to ideal human proportions appear to be different from culture to culture. This section reviews various modular grid systems from ancient to Italian Renaissance times.

It is believed that the first Egyptian cannon was a square grid system used before the 25th dynasty (early-7th century BCE) (Carter, Steinberg, 2010, p.104). With this system, male standing figures were divided into 18 equal parts vertically from the soles of their feet to their hairlines (Figure 4) (Robins, 1994, p.73; Weingarten, 2000, p.103). Key points of the body were marked by the horizontal division lines as follows:

Line 18: Hairline. Line 17: Through or near the bottom of the nose. Line 16: Through or near the junction of the neck and shoulder. Line 14: Through or near the nipple. Line 11: The navel. Line 9: Through or near the lower border of the buttocks. Line 6: Through the knees. Line 0: Below the soles of their feet. (Robins, 1994, p.73; Weingarten, 2000, p.103).

Other horizontal lines did not go through such obvious parts of the body (Robin, 1994, p.74). The vertical lines were drawn symmetrically parallel to the bisection line of the figure (Robins, 1994, p.74; Weingarten, 2000, p.103). Some key points can be defined also according to the position of the relationship between the lines and the body parts. For example, the shoulder width of the body was always six units wide (Robins, 1994, p.74); the width of the narrowest part of the waist was 2 1/4 to 2 1/2 squares (Robins, 1994, p.74).

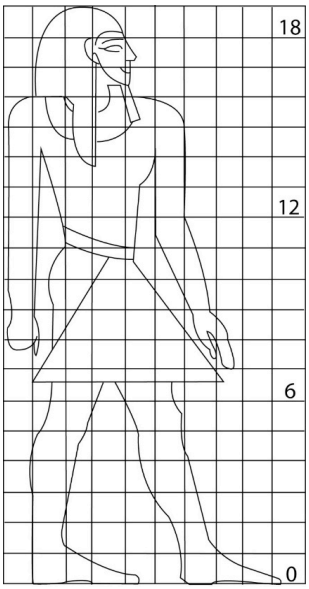


Figure 4. The first Egyptian cannon of proportion: the 18-square division.
Source: Re-drawn from Weingarten, 2000, p.104.

In the 26th dynasty (664-525 BCE) (Carter, Steinberg, 2010, p.104), the second Egyptian cannon replaced the first grid system to provide proportional divisions for human figure drawings. In this later system, male standing figures were divided into 21 equal parts from the sole of their feet to their upper eyelids (Figure 5) (Robins, 1994, p.160; Iversen, 1968, p.217). Key points of the body were divided by the horizontal lines as follows:

Line 21: Through the upper eyelid. Line 20: Through the mouth. Line 19: Through the junction of the neck and shoulder. Line 16: Through or near the nipple. Line 13: Through or near the small section of the back. Line 11: Through or near the lower border of the buttocks. Line 7: Top of the knees. Line 6: Below the bulge of the tibial tubercle. Line 0: Below the soles of their feet. (Robins, 1994, p.160).

A vertical line goes through the ear bisection of the body, and other vertical lines are displayed symmetrically on both sides of the line (Robins, 1994, p.160). The shoulder width is approximately 7 squares; the armpit width is 5 squares and the width of the narrowest part of the waist is 2 3/4 to 3 squares (Robins, 1994, p.163).The body features were, therefore placed between the grid lines rather than on the grid lines (Robins, 1994, p.160). For example, in Figure 5, the outer edges of the shoulder are placed between grid lines instead of placed on the grid lines. Likewise, the edge of upper arm and waist are in the middle of the grid cells.

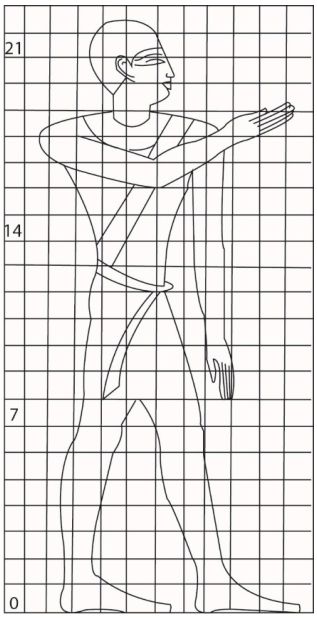


Figure 5. The second Egyptian cannon of proportion: the 21-grid division.
Source: Drawn from Iversen, 1968, p.217.

In the study of Korai (the largest Minoan statue) proportions, Guralink declared that the second Egyptian cannon of proportion was found in both male and female Korai figures, and thus argued that Greek sculptures adopted Egyptian cannon without major modification (Guralink, 1981, p.270). However, in a more recent study, Weingarten (2000, p.106) suggested a 21- grid for the Palaikastro Kouros statue. As can be seen in Figure 6, the 21-grid measurement was between the hairline and the sole of the feet. Using this system, the key points of the statue were proposed as follows:

Line 21: The hairline. Line 18: The widest point of the shoulders. Line 17: The nipples and armpits. Line 11: Top of buttocks. Line 10: Joins of the legs or lower buttocks. Line 6: The top of the knees. Line 1: Ankles. Line 0: Below the soles of their feet. (Weingarten, 2000, p.105).

Furthermore, Weingarten drew the vertical lines on both sides of the middle line and discovered that the widest part of the shoulders occupied 3 units on each side, 'exactly as in the Egyptian cannon' (Weingarten, 2000, p.108).

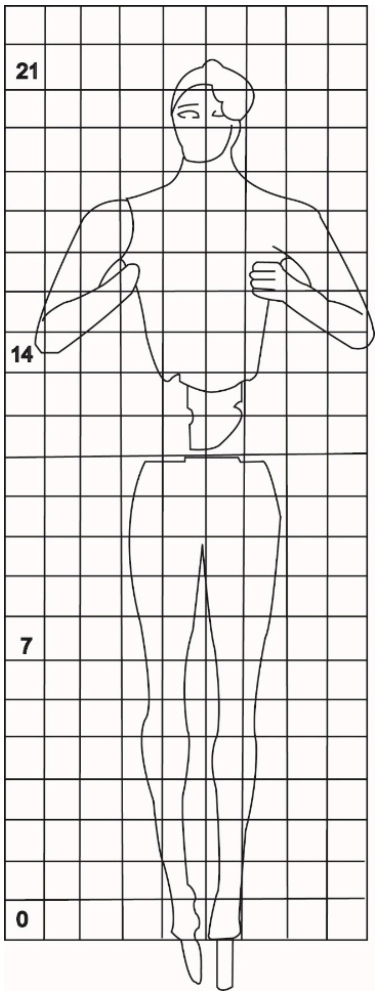


Figure 6. The 21-grid division for the Palaikastro Kouros statue, as proposed by Weingarten. Source: Drawn from Weingarten, 2000, p.106.

Robins set out to discover the proportions of Assyrian figures by applying a 15-grid system to the representations of 125 complete standing figures with human or eagle-headed features from North-west palace of Assurnasirpal II at Nimrud (Robins, 1990, p.107). This grid system divides each figure from the middle of their eyes to the bottom of the soles of their feet into 15 equal parts (Robins, 1990, p.108). Accordingly, the key points in the horizontal direction were found to be:

Line 15: The middle of the eye. Line 13: The forward shoulder (eagle-headed figure only). Line 9: Top of the buttocks. Line 5: The bottom of the kilt. Line 2: 1/2: The calf muscle. Line 0: Line 0: Below the soles. (Robins, 1990, p.109).

Vertically, the division spreads from the body axis like the Egyptian cannon. The width of the body at the buttocks is 3 squares (shown in Figure 7) (Robins, 1990, p.110). Robins also pointed out that although the heights of those Assyrian figures are not the same, the key points of the body are located in a fairly limited range (Robins, 1990, p.116). However, none of them is identical (Robins, 1990, p.116).

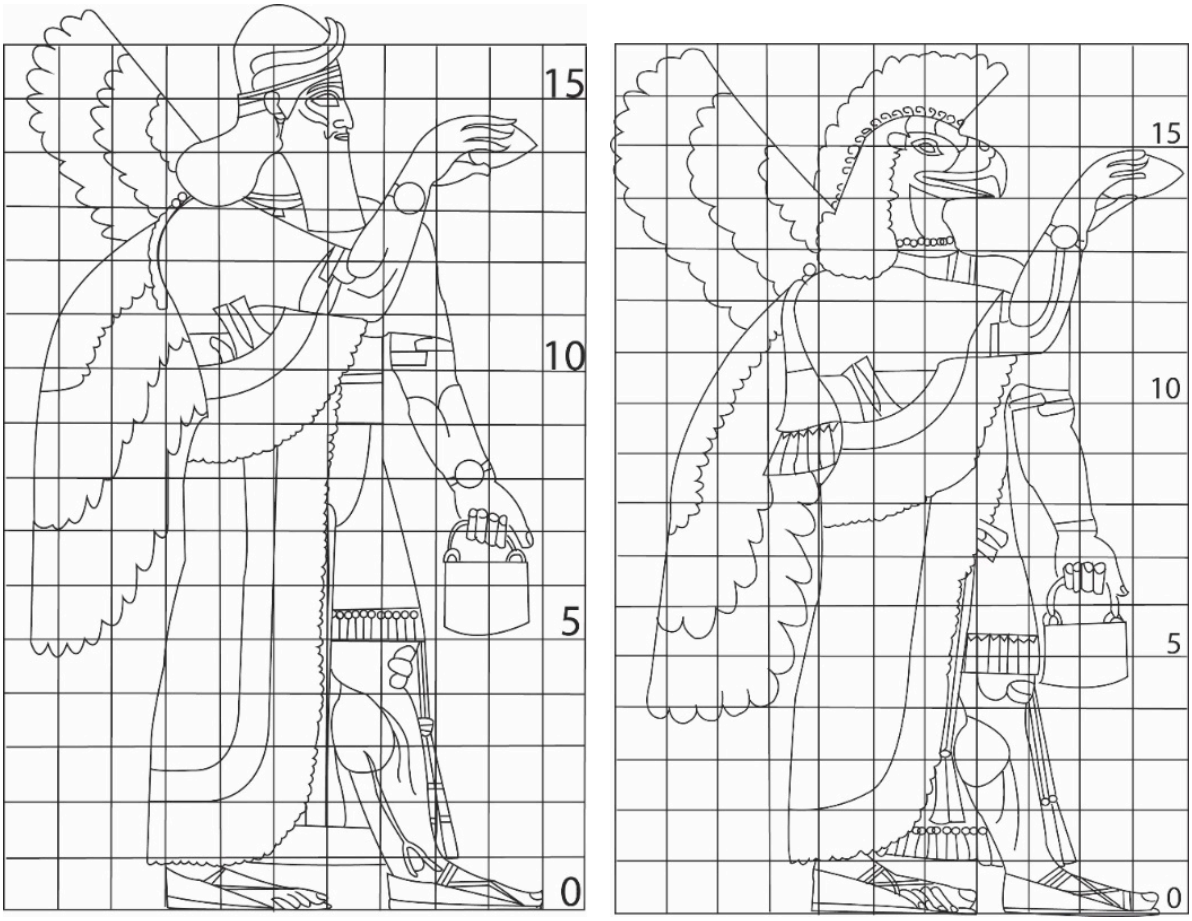


Figure 7. The 15-grid division in Assyrian human and eagle-headed figures.
Source: Drawn from Robins, 1990, p.117.

A proportional system known as ‘Cennini's cannon’ is a proportional division used in Italian Renaissance large-scale sculptures, which divided the human standing figure into 9 face lengths from the top of the head to the bottom of soles of their feet (Zervas, 1976). Evidence for such division was found in Ghiberti's St. Matthew (Figure 8a). The faces of the sculptures are divided into three equal parts. Cennini's cannon can be further interpreted into a 27-grid cannon (9 faces, each divided by 3) from the top of the head to the base of the soles. Figure 8b shows this case. Accordingly, the key points can be listed as follows:

Line 27: Top of the head. Line 22: Pit of the throat. Line 19: Middle of the chest (nipple). Line 16: Navel. Line 13: Thigh joint. Line 7: Knee. Line 0: Sole of the feet. (Zervas, 1976, p.37).

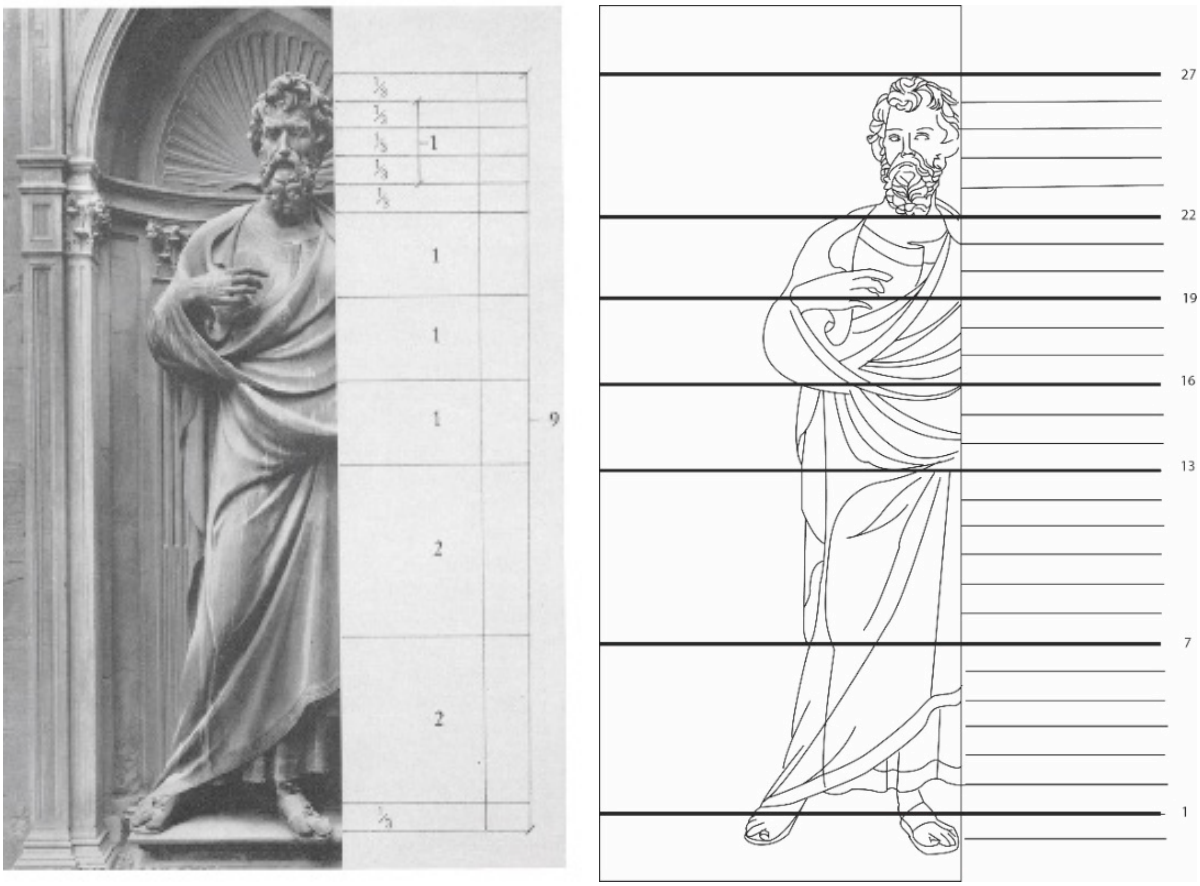
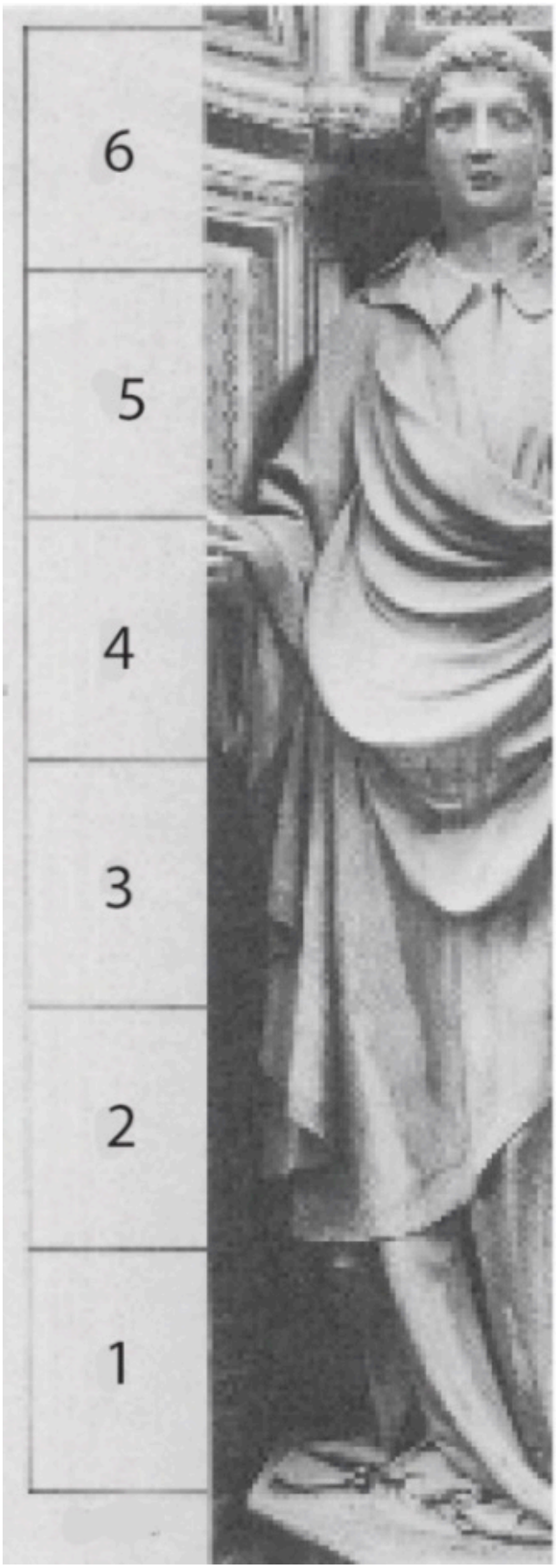


Figure 8. The Cennini's cannon division in large-scale Italian Renaissance sculptures.
Source: Drawn from Zervas, 1976, p.39; Morselli, 1978, p.236.

Alberti, an Italian Renaissance artist, divided the total human height as shown inFigures 9a and b (Morselli, 1978, p.238), a division that fits perfectly on the sculpture of St. Stephen (located in Florence, created by Ghiberti during 1427-28). The key points marked by each division line were: Line 6: The top of the head. Line 5: The shoulders. Line 4: At the lower edge of the sternum. Line 3: At the pubis. Line 2: Above the knee. Line 1: On the shin. Line 0: Sole of the foot. (Morselli, 1978, p.238).

Apart from cannon division, artists also tended to divide the human body by the length of certain body parts. For example, the height of the human body equals to eight head-lengths (Wolf, 1943, p.364); ten face-lengths (Fairbanks, 1988, p.76) or thirty-one nose-lengths (Fairbanks, 1988, p.76). Leonardo da Vinci also studied the proportional relationship between human body parts. He found out that 'four fingers make one palm and four palms make one foot' as well as 'the length of a man's outspread arm is equal to his height' (Creed, 1986, p.1541).

All the cannons mentioned above are based on multiples of 3. (For example, 27, 21, 18, 15 and 6). All the base lines are located at the bottom of soles of the feet. Only the top reference lines vary from the top of the head to the middle of the eyes.



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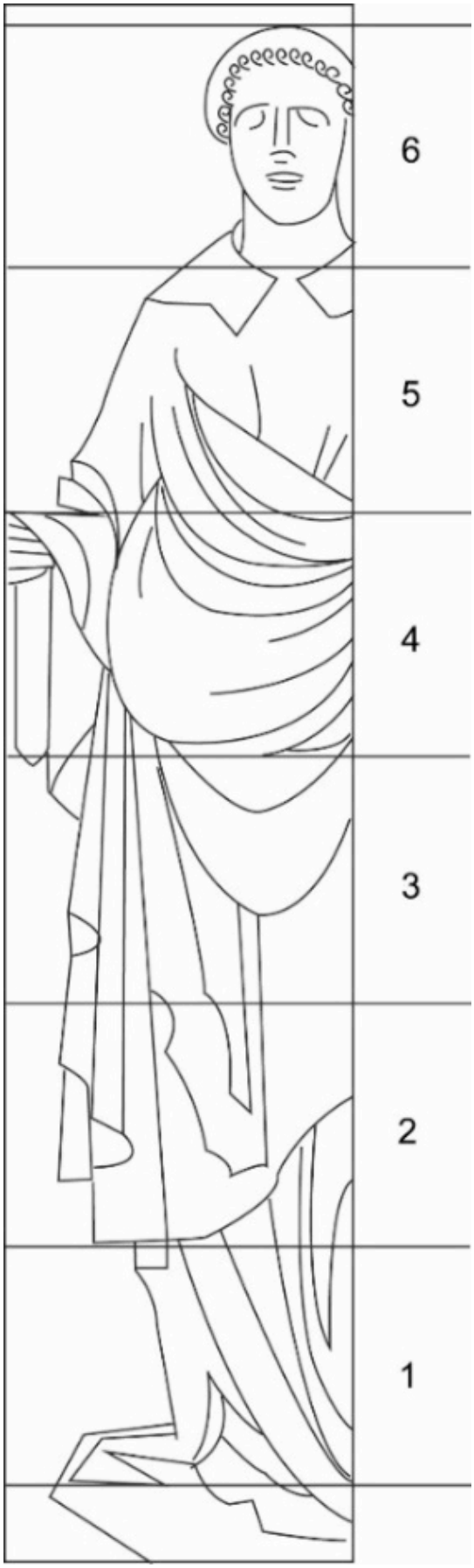

b

Figure 9. Alberti's 6 grids division on St. Stephen sculpture. Source: Drawn from Morselli, 1978, p.238.

Apart from the grid proportions, other methods relating to anthropometry has been proposed. For example, Le Corbusier divided the human body by using the 'modular' (Wittkower, 1960, p.212; Arnheim, 1955, p.48). He claimed that a standing male's height with raised arms can be divided into 2 equal parts at navel, meanwhile, the same division point (the naval) divides the human height without raised arms into a golden mean (Wittkower, 1960, p.212; Arnheim, 1955, p.48). Vitruvius' measured the human body by using the lengths of different body parts (Arnheim, 1955, p.51). For example, the total height of the human body can be measured by the length of 8 heads; 10 fces; 10 hands; 6 feet and 4 cubits (Arnheim, 1955, p.51). Furthermore, Tobin (1975, p.309) found √2 proportions exist in human body. He first declared that a √2 proportion exist in the length of the sections within the little figure sections, then the entire length of the little figure relates to the palm-wrist length in a √2 ratio. By multiplying this √2 ratio, he reached the length of forearm, the upper arm, head to clavicle, head to nipple, head to abdomen, groin, knee cap and the bottom of feet (Tobin, 1975, p.308-310).

The following section studies the proportion of Terracotta Warrior standing figures. The hypothesis is based on the literature reviewed.

5 Analysis and the development of a novel 15 square grid

Cannons of proportion (Weingarten, 2000, p.104) divide the human body into equal square grids according to a certain standardization of their natural proportions (Iversen 1968, p.215; Robins, 1994 p.23). This section explains the development of a suitable system of analysis and its application to two sample figures. After applying the common types of grid systems (explained previously) to the terracotta warrior figures, none of them showed a convincing relationship between the grid division lines and the key points of the body.

In the study of Assyrian standing figure proportions, Robins took the distance between the top of the knee and the bottom of the sole as a unit of measure, three units from the sole of the feet reached the middle of the eye (Robins, 1990, p.108). Then he sub-divided each unit into five equal grids. Therefore (as noted above and illustrated in Figure 7), the Assyrian figures were divided into 15 grid divisions from the middle level of their eyes to the bottom of their soles (Robins, 1990, p.108). With most terracotta warrior standing figures, most key points of the body were obscured by armour and robes worn, especially key points such as nipples, navel, and knees. Thus, the method Robin used to define the upper reference point is not suitable in this study. Because most cannons can be divided by three, the division of three was used as a starting point of terracotta warrior proportional division.

Similar to all the cannons reviewed previously, the bottom of the soles of the feet was considered as a baseline, which is the lower reference point. After applying the division of three and various sub-divisions (5, 6, 7, and 9) between the baseline and various upper points (including the top of the head, hairline, upper eyelid and middle of the eye), it was observed that a 15-grid division between hairline and baseline makes more sense than other types of grids, as most horizontal division lines go through key points of the body. Thus, the bottom of the soles of each figure's feet was the lower reference point, while the hairline was considered as the upper reference point. The distance between the upper and lower reference points was divided into three equal sections, then each section was further divided into five equal parts. In other words, a 15-grid system from hairline to the bottom of the soles

was chosen as the grid type most suitable to the study of terracotta warrior proportions. Following the example given by Robins, measurements were calculated in square units, half squares and quarter squares (Robins, 1990, p.109).

6 The application of the proposed grid to the sample figures

Figure T1G2: 22 in Zhao, 1988, p.80 is one out of 35 warrior figures. The height from the soles of the feet to the top of the head measured 178 cm (Zhao, 1988, p.355). The distance between the soles and hairline is calculated as 172.25 cm. When a grid model of 11.48 cm square grid system is placed over the figure (Figure 10), the underlying structure marked by the horizontal grid lines can be listed as follows:

Line15: The hairline. Line 13: Through the junction of neck and shoulder. Line 11: Through or near the nipple. Line 9: Through or near the small section of the back. Line 4: Through the top of the knees. Line 0: Below the soles of the feet. Although the positions of the nipple and knee are obscured in the figure, Line 11 and line 4 still marked the approximate position of these two key points. Unlike Egyptian or Assyrian figures, this figure cannot be symmetrically divided in a vertical direction. The width of the body occupied 5 grid units, and the narrowest part of his waist took 3 and a half units.

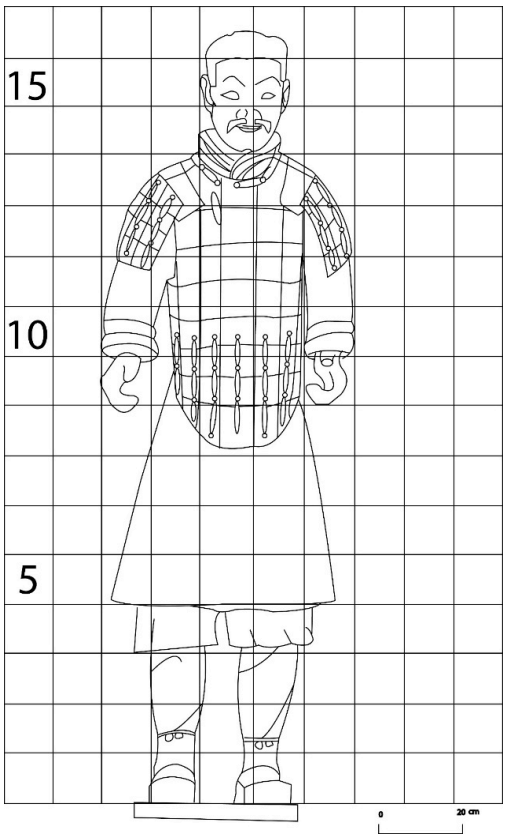

Figure 10. The application of the proposed grid to Figure T1G2: 22 from Zhao (1988).

When the same grid is applied to an unarmoured figure T10G7:10 in Zhao, 1988, p.70, the scale of the grid units are slightly smaller than the previous case (T1G2: 22), as the measurement of T10G7:10 from top of his head to the bottom of his sole is 176 cm (Zhao, 1988, p.364). The distance between his sole and hairline is calculated 170 cm; therefore, the

length of each grid unit is 11.35 cm. Figure 11 illustrates this case. The horizontal division lines mark the following key points:

Line15: The hairline. Line 13: Through the junction of neck and shoulder. Line 11: Through or near the nipple. Line 9: Through or near the small section of the back. Line 4: Through the top of the knees. Line 0: Below the soles of the feet.

In this case, line 11 and line 4 mark the position of the nipple and knee respectively, where these two points are obscured by the robe.

Horizontally, the figure occupies slightly less than 5 units, almost two and a half units on each side of the bisection line. The narrowest part of the body takes approximately two and a half units.

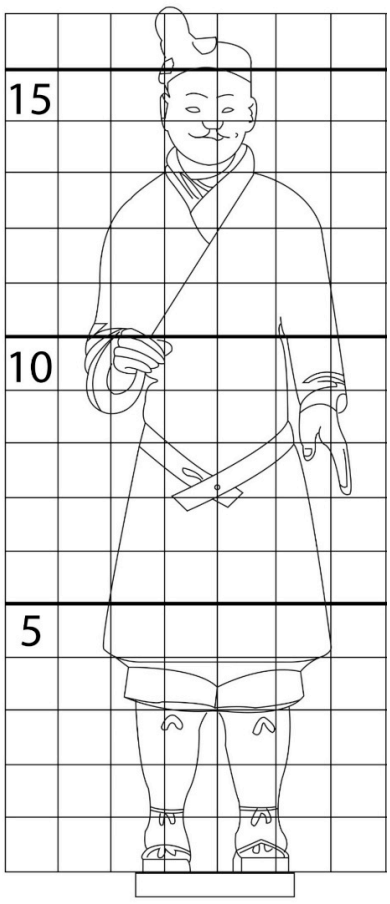

Figure 11. The application of the proposed grid to Figure T10G7: 10 from Zhao (1988).

7 Results

After applying the same division method and the proposed grids to 35 standing terracotta figures, the key points which are marked by the horizontal division line can be summarised as follows:

Line 15: marks the hairline in all cases. Line 13: through the junction of neck and shoulder or very close to the junction of neck and shoulder in 28 samples, 4 samples have this line half a unit below the junction of neck and shoulder, the other 3 sample figures have this line a quarter of a unit below the junction. Line 11: marks or gives a near position of nipples in 27

cases. Line 9: goes through the narrowest part of the waist in 33 out of 35 samples. Line 4: marks the top of knee in all samples. Line 0: as the baseline, was placed at the bottom of the feet in all cases.

The width of the sample figures varied from 4 to 6 units, among which three pieces were with a width of 6 units, one piece with 4 units, 16 with 5 or almost 5 units, and the other 15 figures with 5.5 units.

The detailed relationship between the key points and the grid division lines is listed in Table 1.

Table 1 Relationship between the key points and the proposed grid division lines

Serial number	Width (Units)	Line 15	Line 14	Line 13
T1G2				
8	5	Hairline	Bottom nose	Junction of neck and shoulder
22	5	Hairline		Junction of neck and shoulder
23	4.5	Hairline	Bottom nose	1/2 grid below the junction
39	5	Hairline	Bottom nose	Junction of neck and shoulder
T1G3				
6	almost 5	Hairline		Junction of neck and shoulder
7	5	Hairline		Junction of neck and shoulder
13	4.5	Hairline		Junction of neck and shoulder
T1K				
17	5	Hairline	Bottom nose	1/2 grid below the junction
72	4.5	Hairline	Bottom nose	Junction of neck and shoulder
74	5.5	Hairline		Close to junction of neck and shoulder
155	5	Hairline	Bottom nose	Junction of neck and shoulder
T2G2				
97	5.5	Hairline		Junction of neck and shoulder
T10G5				
3	5.25	Hairline		Junction of neck and shoulder
6	4.5	Hairline		Junction of neck and shoulder
12	6	Hairline		Close to junction of neck and shoulder
15	5.5	Hairline		1/4 grid above the junction
T10G6				
35	6	Hairline	Bottom nose	1/2 grid below the junction
T10G7				
10	almost 5	Hairline		Junction of neck and shoulder
T10K				
98	5	Hairline		Junction of neck and shoulder
105	5	Hairline	Bottom nose	Junction of neck and shoulder
111	5and a bit over	Hairline	Bottom nose	1/4 grid below the junction
T19G9				
2	5.25	Hairline		Close to junction of neck and shoulder
3	5	Hairline	Bottom nose	1/2 grid below the junction
16	almost 5	Hairline	Bottom nose	Close to junction of neck and shoulder
T19G10				
2	4.5	Hairline	Bottom nose	Junction of neck and shoulder
12	5	Hairline		1/4 grid below the junction
14	5.5	Hairline		Close to junction of neck and shoulder
17	5	Hairline	Bottom nose	Close to junction of neck and shoulder
24	almost 6	Hairline		Junction of neck and shoulder
25	5	Hairline	Bottom nose	Close to junction of neck and shoulder
31	5.5	Hairline		Junction of neck and shoulder
T19K				
139	4.5	Hairline		Junction of neck and shoulder
T20G9				
58	5	Hairline		Junction of neck and shoulder
T20G10				
88	almost 5	Hairline	Bottom nose	Junction of neck and shoulder
98	4	Hairline		Junction of neck and shoulder

Table 2 Relationship between the key points and the proposed grid division lines (continued)

Serial number		Line 11	Line 9	Line 8	Line 4	Line 0
T1G2						
8		Nipples		Small of the back	Top knee	Sole of the feet
22		Nipples	Small of the back		Top knee	Sole of the feet
23			Small of the back		Top knee	Sole of the feet
39		Nipples	Small of the back		Top knee	Sole of the feet
T1G3						
6		Nipples	Small of the back		Top knee	Sole of the feet
7		Nipples	Small of the back		Top knee	Sole of the feet
13		Nipples	Small of the back		Top knee	Sole of the feet
T1K						
17		Nipples	Small of the back	Bottom of belt	Top knee	Sole of the feet
72		Nipples	Small of the back	Top of belt	Top knee	Sole of the feet
74			Small of the back		Top knee	Sole of the feet
155		Nipples		Small of the back	Top knee	Sole of the feet
T2G2						
97		Nipples	Small of the back		Top knee	Sole of the feet
T10G5						
3		Nipples	Small of the back		Top knee	Sole of the feet
6		Nipples	Small of the back		Top knee	Sole of the feet
12			Small of the back		Top knee	Sole of the feet
15		Nipples	Small of the back		Top knee	Sole of the feet
T10G6						
35			Small of the back		Top knee	Sole of the feet
T10G7						
10		Nipples	Small of the back		Top knee	Sole of the feet
T10K						
98			Small of the back	Top of belt	Top knee	Sole of the feet
105		Nipples	Small of the back	Bottom of belt	Top knee	Sole of the feet
111		Nipples	Small of the back	Bottom of belt	Top knee	Sole of the feet
T19G9						
2		Nipples	Small of the back		Top knee	Sole of the feet
3			Small of the back		Top knee	Sole of the feet
16		Nipples	Small of the back		Top knee	Sole of the feet
T19G10						
2		Nipples	Small of the back		Top knee	Sole of the feet
12			Small of the back		Top knee	Sole of the feet
14		Nipples	Small of the back		Top knee	Sole of the feet
17			Small of the back		Top knee	Sole of the feet
24		Nipples	Small of the back		Top knee	Sole of the feet
25		Nipples	Small of the back		Top knee	Sole of the feet
31		Nipples	Small of the back		Top knee	Sole of the feet
T19K						
139		Nipples	Small of the back		Top knee	Sole of the feet
T20G9						
58		Nipples	Small of the back		Top knee	Sole of the feet
T20G10						
88		Nipples	Small of the back		Top knee	Sole of the feet
98		Nipples	Small of the back		Top knee	Sole of the feet

There is no evidence to show in this study that the grid unit size is based on the length (or width) of the nose, hands or other parts of the body.

Therefore, although there is no evidence that the ancient Chinese applied a particular cannon to provide a guideline for the proportions of human figures, the division of three and the use of a 15-grid system (shown here) indicate that some key body parts of the sample figures do fall on or are located close to certain grid lines, even though the heights and width of the sample figures are different. In other words, although no two identical proportions are found, the proposed division and grid system suggested that the ancient Chinese crafts people did follow certain proportion systems when producing terracotta warrior figures.

The reason that all of the figures were not lined exactly the same way may be due to the Terracotta Warrior production methods, which are a mix of mass production and detailed engraving. Archaeological evidence shows that several types of modules were used to produce rough shapes (Zhao, 1988, p.499). Furthermore, different details may be added on armour (4 types of armour mentioned in section 2), with the combination of different face shapes and sizes (Zhao, 1988, p.499), made it almost impossible to find 2 identical figures.

8 Conclusions

This paper firstly reviewed proportions in the human body in different measurement systems (including the proportions provided by grids and the proportions in anthropometry). Then a 15-grid system was developed, which may has been used as guidelines to govern the proportions of terracotta warrior standing figures. The hypothesis was based on the previous literature of square grids used in ancient Egyptian paintings, ancient Greek sculptures and Assyrian sculptures, each indicating proportional reference points for parts of the Terracotta figure. There is no evidence to show in this study that the grid unit size is based on the length (or width) of the nose, hands or other parts of the body.

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About the Authors:

Chaoran Wang: Lecturer in Design at Lancaster University (UK). Research interests: Structure and form in visual arts, design and architecture. In particular, the geometric structures underpinning two-dimensional imagery.

Michael Hann: Chair of Design Theory at the University of Leeds (UK). Interested in the geometry of design. Key publications include: *Structure and Form in Design* (2012, Berg), *Symbol, Pattern and Symmetry* (Bloomsbury, 2013), *Stripes, Grids and Checks* (Bloomsbury, 2015), *Patterns: Design and Composition* (Routledge, 2019) *The Grammar of Pattern* (CRC Press, 2019).