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CONTENTS

The "Veiled Image" and "Constantly Amplifying the Feeling" in Billy Jackson's <i>Station</i> Klaus G. Witz	1	Symmetries in the Mind: Production, Perception, and Preference for Seven One-Dimensional Patterns Dorothy Washburn and Diane Humphrey	57
Being In and Among: Understanding Through Conversation in the Art Museum Jennifer Eiserman	16	The "Golden Woman:" An Exploratory Study of Women's Proportions in Paintings Vladimir J. Konečni and Laney E. Cline	69
Collaborative Drawing During Early Mother-Child Interactions Gregory S. Braswell	27	Behind Closed Doors: The Art, Art Making, and Experience of Incarcerated Women Rachel Marie-Crane Williams	79
Swimming in the Invisible Sea: Children, Artists, and Art Education Reform Theresa Marché	40	Dissertations Reported	95
Aesthetic Thinking of Young Children and Adolescents Jo Chiung-Hua Chen	47		

The “Golden Woman:” An Exploratory Study of Women’s Proportions in Paintings¹

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Abstract

The purpose of this exploratory correlational study was to examine, for both psycho-aesthetic and socio-biological reasons, the painters’ differential use of the golden section (0.618) and other proportions when depicting women. Two facial ratios (cheekbone width over face length; bi-section at eyebrows) and two bodily ones (bi-section at the navel; waist-to-hip) were computed on 28 female figures. In addition, 81 students assessed the age and physical attractiveness of the portrayed women. The figures were located in 24 works by 16 painters, dating mostly from the first half of the 20th century. These works were drawn from a larger, quasi-random sample of 95 20th-century paintings, such that each work that contained a female figure was included in the present sample. The results showed the expected strong attractiveness bias in favor of the younger figures. More importantly, the most attractive figures were found to differ significantly from the rest of the sample—in terms of the mean or variability or both—for three of the four measured ratios. Both the ratios of cheekbone width over face length and the bi-section at the navel were, in line with classical ideals, at the golden section for the most attractive subgroup, which also displayed significantly less waist-to-hip variability than the rest of the sample (around the common mean of 0.69). The possible role of paintings as intuitive transmitters of the accumulated cultural wisdom regarding women’s proportions, attractiveness, health, and reproductive fitness is discussed.

Aestheticians’ and psychologists’ long theoretical and research fascination with the golden section has all too rarely manifested itself in the empirical scrutiny of authentic paintings (Green, 1995), as opposed to artificial stimuli, such as lines and rectangles, usually devoid of context. This

fact might constitute at least a partial explanation for the elusiveness (Boselie, 1992; Hoeye, 1995) of this proportion—“divine,” according to Johannes Kepler—that has been known and used mainly by European elites since Greek antiquity (Arnheim, 1966; Berlyne, 1971; Bouleau, 1963; Fechner, 1876).

The senior author’s research program on the golden section has involved a number of steps. The first was to contextualize the golden section in a series of three experiments with regard to both the object that was investigated and its spatial placement (Konečni, 1997). This was followed by using practicing painters as research participants—a rare thing in itself in psycho-aesthetics—in a study that modified Fechner’s “method of production” to capture the painters’ differential processing of the golden section and other theoretically significant proportions. These various proportions were presented to the research participants both as elements of the contextualized, but semi-artificial, aesthetic stimuli and in authentic paintings by several artists—who could be reasonably assumed to have introduced the golden section with various degrees of conscious intention (Konečni, 2000).

The last-mentioned study was perhaps the first in the literature to use the proportions (“golden” and other) *within* authentic paintings as stimuli presented to the subjects. This, of course, necessitated the painstaking measurement of the structural elements of paintings. Knowledge thus gained was next used in the third stage of the project, in which (a) the structural and compositional elements, (b) both the verti-

cal and horizontal balance bi-sections, and (c) the overall dimensions, were all measured in 95 20th-century paintings, selected from an initial pool of 250 (Konečni, 1999; in press). Each of the 95 paintings contained at least one golden section and the question was how it was used, and whether and how, given the presence of the golden sections, other proportions had been introduced by the artists.

The present paper focuses on an intrinsically interesting sub-sample of those 95 works—24 paintings in which women are represented. These paintings, by definition, contain at least one golden section [in terms of the criteria described in (a), (b), and (c) above]; however, they were neither separately analyzed in the prior reports (Konečni, 1999; in press), nor were the necessary measurements pertaining specifically to women's faces and bodies previously made. Whereas we have no intention of breaking up without end an already modest in size, though very carefully selected, sample of 95 paintings into sub-samples, there is potential benefit for both empirical aesthetics and evolutionary psychology from an exploratory examination—one involving additional measurements and other new data concerning this sub-sample—of how certain female proportions have been rendered by a number of modern painters. For aestheticians, the interest lies in how the golden section and other proportions have been used in presenting one of the most important themes in Western art. For evolutionary psychology, such contemporary pictorial representations of women are of interest in that they may intuitively summarize, in the work of some very talented artists, the accumulated beliefs regarding the relationship of the female bodily proportions and reproductive fitness—perhaps mediated by attributes such as age, health, and attractiveness.

Mirror symmetry of the body shape with regard to the central vertical axis (or bilateral symmetry, which biologists have long used as a reliable indicator of developmental stability) is associated in humans and other species with health and attractive-

ness (e.g., Buss, 1994; Gangestad & Thornhill, 1997; Hersey, 1996; Møller & Thornhill, 1998; Thornhill, 1993; Thornhill & Gangestad, 1999), though there are some interesting, long-observed exceptions (McManus, 1976). But the ratio of the upper to the lower portions of the human body with regard to the horizontal axis, placed since antiquity at the navel, is also very important in the perceived attractiveness of both men and women. The Greek ideal for this ratio was 0.618, the golden section (to three decimals). Body measurements by Zeising (1854) showed the averages for women and men at $5/8$ (0.625) and $8/13$ (0.615), respectively (with these three integers all being members of the Fibonacci row of 1, 1, 2, 3, 5, 8, 13, 21, 34..., in which, at $21/34$, the first three decimals of the golden section, an irrational number, are correctly revealed).

However, with regard to the ratio of the respective circumferences around the waist and hips, not the golden section, but 0.70, has consistently been associated with both female corporeal beauty and fertility. Singh and colleagues (Joiner, Schmidt, & Singh, 1994; Singh, 1993, 1994; Singh & Luis, 1995) have extensively studied the adaptive significance of this waist-to-hip ratio in various ethnic groups and for respondents of both genders and a broad span of age.

Facial proportions in humans are also crucially involved in the judgments of both health and attractiveness (e.g., Cunningham, 1986; Katz, 1999; Scheib, Gangestad, & Thornhill, 1999; Thornhill & Grammer, 1999). Averageness (the prototypicality achieved in composite faces—see Langlois & Roggman, 1990), symmetry (e.g., Grammer & Thornhill, 1994), and deviations from the prototype (Johnston, 2000; Johnston & Franklin, 1993; Perret, May, & Yoshikawa, 1994) all seem to play a part in the judgments of female attractiveness under certain conditions. Two specific facial proportions have long been regarded as important in portraiture (Konečni, 1991). One of these is the "facial cross"—the ratio of the distance be-

tween the cheekbones to that between the hairline and the chin, which is anecdotally thought to fall in the golden-section region in well-proportioned faces. The second is the ratio of the distance between the eye-brow-midpoint to the chin to that between the hairline and the chin, thought to fall ideally in the .66 - .69 region. However, neither of these proportions seem to have been investigated in either the psycho-aesthetic or the socio-biological literature³, nor are they firmly established conventions, at least not in the sense of being given numerical values in texts on painting.

Therefore, for the present report, two facial and two bodily proportions of each female figure in the sample of 24 works were measured (that is, whenever such measurements could be reliably made). Note that *none* of these measurements had been included [notably under criterion (a), above] in the prior reports (Konečni, 1999; in press). The advantage of making additional measurements on this same sample of 24 works is that the interpretation of the new data could conceivably be aided by the previously obtained information regarding the presence of the golden sections and other proportions in these paintings. Such considerations, and the exploratory nature of the present research, hopefully justify the rather small sample of paintings.

As an additional aid to interpretation, a set of ratings data was obtained as part of the present study from a relatively large sample of research participants. These people rated the 28 female figures in the 24 paintings on a number of dimensions. Only the two most relevant ratings—age and attractiveness of the portrayed women—will be reported and discussed in the present paper.

Some of the questions we attempted to answer were: (1) Is there a relationship between the perceived age and the perceived attractiveness of the female figures? (2) Did the painters portray the faces and bodies of the younger and/or more attractive women using different proportions from those of the women perceived as older and/or less attractive, and, especially, which

role, if any, does the golden section play in any such differences? (3) If the sub-group of the figures rated both young and attractive is different from the rest of the sample in terms of the proportions by which they are characterized, is the difference predominantly one of size (mean) or variability (dispersion)? After all, given the somewhat restricted range that can be reasonably expected in the portrayal of female facial and bodily proportions, variability may well be an accurate measure of the artists' collective intent in rendering youth and attractiveness. (4) Should the sub-group of the most attractive women be more likely than the rest to have the golden sections in some of their facial ("facial cross") and bodily (top/bottom division at the navel) proportions (the present, new, data), are the paintings in which such women are portrayed also more likely to have a relatively higher number of golden sections in their *other* structural elements (using the data from Konečni, in press)?

Method

The sample of 24 paintings

The measurement and other inclusion criteria by which the full sample of 95 paintings was selected from a pool of about 250 is described in detail elsewhere (Konečni, in press). In order to reduce any subtle bias, the selection procedure was intentionally conducted by research assistants who were not specialists in the visual arts or evolutionary psychology and who were unaware of the overarching goals of the research. Their choice was quasi-random, governed in large part by the availability of large-size, good quality reproductions in a number of Southern California libraries, as well as other logistical considerations. The 95 works were by 52 painters and all the decades of the 20th century were represented to some extent; as a result of applying the three criteria described in the introductory section of the present paper, each of the paintings contained at least one example of the golden section.

No instructions whatsoever had been given to the research assistants regarding the inclusion of paintings portraying women into the original sample. Furthermore, none of the 95 paintings in that sample that portrayed a woman was excluded from the present, "female" sub-sample. The choice of the 24 paintings presently under consideration can thus be considered both quasi-random and "blind."

There are a total of 28 women and girls depicted in the 24 paintings in the present sample (two small female children were eliminated from consideration). Each of the paintings, by definition, contains a golden section as described above. All of the works (arranged chronologically from 1900 to 1967, and painted by a total of 16 painters), their spatial orientations, and the ratios of their dimensions are listed in the Appendix. All the artists are male, which may limit the generality of the conclusions.

Ratings of the portrayed women

Eighty-one, mostly psychology, students (50 women, 31 men, with the responses not analyzed separately) from the University of California, San Diego, assessed the age and physical attractiveness of the 28 portrayed women. The ratings were made in an auditorium. The slides of all 24 paintings were shown twice. On each occasion, each slide was shown for eight seconds, during which time the respondents rated the female figure(s). Age of the portrayed women was rated while watching the slides the first time (Old, Middle-Aged, Young, Child), followed by attractiveness, during the second showing ("How physically attractive do you find this person?") Responses were on a seven-point scale, 1 = "not attractive," 7 = "very attractive"). Research participants were thus specifically instructed to rate the physical attractiveness of the female figures, not the beauty or quality of the paintings.

Subsequently, interviews with a further 27 research participants (17 female and ten male psychology students), who were taking part in unrelated psycho-aesthetic stud-

ies, provided some clarifying age and attractiveness data.

Facial and bodily proportions

The four new measurements (two of the facial and two of the bodily proportions) were as follows:

Facial Cross: The ratio of the distance (in mm) between the outer edges of the cheekbones to the distance from the hairline to the tip of chin. (The greater the value of the ratio, the rounder the face; the smaller the value, the longer the face. The traditional ideal: 0.62, the golden section region.)

Facial Bi-Section at Eyebrows: The ratio of the distance between the eyebrow midpoint and the tip of the chin to the distance between the hairline and the tip of chin. (The bigger the ratio, the lower the forehead; the smaller the ratio, the higher the forehead. The traditional ideal: 0.67, the two-thirds region.)

Body Bi-Section at the Navel: The ratio of the distance from the top of the head to the navel to the distance from the navel to the soles of the feet. (The bigger the ratio, the shorter the legs; the smaller the ratio, the longer the legs. The traditional ideal: 0.62, the golden section region.)

Waist-to-Hip Ratio: The traditional ideal: the 0.70 region. (See Radke-Sharpe, Whitney-Saltiel, & Rodin, 1990, and Singh, 1993, for the detailed measurement information.)

Measurements of the proportions of the female figures were made independently by two raters (one male, one female), with a high inter-rater agreement (.89).

Results

Perceived age and attractiveness

Eighty-one research participants placed each figure into one of four age categories. The modal classifications were as follows: For three of the figures, Old (paintings No. 1, 3, and 9 in the Appendix), for 10 figures, Middle-Aged (No. 4, 6, 10, 11,

14, 15, 18, 20, 21, 22), for 12, Young [No. 2, 5, 8, 16, 17 (four figures), 19, 23, 24 (two figures)], and for the remaining three of the figures, Child (No. 7, 12, 13).

Subsequent interviews with 27 additional subjects placed the ages of the three figures in the Child category in the regions of 15 - 20 years (No. 7), 8 - 12 years (No. 12), and 11 - 14 years (No. 13), and the three figures in the Old category in the regions of 30 - 39 (No. 1), 35 - 45 years (No. 3), and 40 - 54 (No. 9). Thus, the overall age range of the 28 figures can be said to be approximately between 10 and 47.

Attractiveness was rated on a seven-point scale by 81 participants (1 = "not attractive," 7 = "very attractive"); the range was 2.75 - 5.65 and the Mean 4.31 (SD = 0.91). In order to create a meaningful comparison of the perceived-age groups in terms of attractiveness, the Old and Middle-Aged categories were combined into one, OM group (comprised of 13 members, $M = 3.81$, $SD = 0.56$), as were, analogously, the Young and Child categories, into the YC group (with 15 members, $M = 4.75$, $SD = 0.95$). This OM vs. YC difference is highly significant: $t(26) = 3.12$, $p < .01$.

Judging at least by the paintings in this sample, when painters portray women that are perceived as younger, they generally do it in such a way that they are also very reliably perceived as more attractive. It is of interest that such a strong relationship is found even in a small sample of works painted in a century generally much given to stylization and omission of detail.

Facial and bodily proportions

Do the four facial and bodily proportions defined above represent at least some of the means at the artists' disposal to convey attractiveness?

Given the main goals and the exploratory nature of the study, and the small sample size, the potentially most informative way of examining the painters' differential use of proportions in female figures is to compare the figures perceived by the judges as the most attractive to the rest of

the sample (as opposed to using, for example, the median split).⁴ Two groups of unequal size were therefore formed. Attractive (A) group, consisted of the eight figures that had received the highest attractiveness ratings, in the top third of the seven-point scale ("5" and above; 29% of the sample; $M = 5.35$, $SD = 0.24$). These eight figures were located in six paintings (25% of the sample): No. 2, 5, 8, 12, 13, and three of the four figures in No. 17. All the figures were obviously from the YC group; six of the eight had been classified as Young (of the 12 in that category) and two as Child (of the three in that category).⁵

The second, Less Attractive (LA) group, consisted of 20 figures ($M = 3.89$, $SD = 0.72$). All 13 OM members were in this group, as well as seven members of the YF group (six Young, one Child)

Facial cross (FC). Due to the ways in which the figures were painted, the measurements necessary for the FC computation could confidently be made for only 13 figures, ten in the LA group ($M = 0.581$, $SD = 0.077$, range = 0.50 - 0.73) and three in the A group ($M = 0.623$, $SD = 0.015$, range = 0.61 - 0.64). The mean of the observations in the A group, few as they are, falls essentially at the golden section—the ideal for the facial cross. The mean of the LA group is smaller, indicating faces somewhat more elongated than the ideal (though the difference is obviously not statistically significant).

There is, however, a considerable difference in *variability* between the two groups. Even when this difference is properly tested, using variances, rather than standard deviations (because of the small sample), and with only two *df* for the denominator, the $F(9,2)$ of 25.36 is significant at the .05 level (two-tailed).

One may therefore tentatively conclude that using FC ratios that are removed from the golden section is one of the ways to achieve reduced attractiveness.

Facial bi-section at eyebrows (FBE). Fifteen measurements necessary for computing the FBE were possible in the LA group ($M = 0.692$, $SD = 0.032$) and seven

in the A group ($M = 0.671$, $SD = 0.030$). This difference is not statistically significant [$t(20) = 1.43$, $p < .17$, two-tailed], nor is there a difference in variability between the two groups.

Means of both groups are very close to the ideal two-thirds FBE, with the A group almost exactly at it—that is, an average forehead that is one-third of the hairline-to-chin distance. However, at least in this sample, this facial proportion is not consistently used to distinguish between the attractive and less attractive women's faces.

Body bi-section at the navel (BBN).

Even though measurements of the BBN could be made for only ten of the 28 figures—six from the LA and four from the A group—the results were quite informative. In the case of the LA group, the Mean BBN was 0.763 ($SD = 0.134$, the range = 0.56 - 0.91), whereas for the A group the Mean was 0.627 ($SD = 0.022$). This difference is marginally significant [$t(8) = 1.96$, $p = .085$, two-tailed]. Moreover, there was significantly more variability in BBN in the LA than in the A group [$F(5,3) = 36.75$, $p < .01$].

It appears that when a woman's whole figure is shown, one way of indicating beauty is with a BBN close to the golden section. Reduced attractiveness is conveyed by deviations from that ideal. In the present examples of less attractive women, the painters' tendency was to shorten the legs—sometimes grotesquely.

Waist-to-hip ratio (WHR). The WHR could be calculated in 14 figures, eight of which were in the LA group (Mean = 0.690, $SD = 0.069$, Range = 0.59 - 0.82) and six in the A group (Mean = 0.692, $SD = 0.012$, Range = 0.68 - 0.71).

The two groups thus have almost identical means, but drastically different variability [$F(7,5) = 40.08$, $p < .01$], such that the female figures that were rated the most attractive by the student judges have, without exception, a WHR close to the ideal 0.70, whereas in the LA group few figures have such a WHR—despite the group average falling close to it.

Other golden-section attributes of the A group

Do the painters place attractive female figures in settings of attractive proportions? Specifically, since the golden section was significantly involved in both the FC and BBN conduits of attractiveness, it is of interest to compare the six paintings in which the eight figures in the A group are located to the remaining 18 paintings—with regard to their other respective golden-section attributes. Such comparisons involve a recourse to the data on the 24 paintings that were presented in Konečni (in press).

The six paintings in which the eight A figures are shown contain a total of 13 golden sections in their compositional elements and structural details, or 2.17 per painting (which excludes the present facial and bodily measurements, as well as the painting-dimension, vertical bi-section, and horizontal bi-section measurements). In contrast, the rest of the 18 paintings collectively contain 47 instances of the golden section (2.61 per painting). This difference is negligible, with an $F(22)$ value close to 1.00. Nor do these six paintings differ from the other 18 with regard to the average use of proportions involved in the overall picture dimensions or in the vertical or horizontal picture bi-section.

That said, the fact is that the most attractive female form (Duncan's *Kelpie*, No. 8) is in a painting with four compositional golden sections (well above the median), and that both paintings by Bakst (No. 2 and 5, the 3rd and 6th most attractive figures) contain "golden" bi-sections—vertical (No. 2) and both horizontal and vertical (No. 5; see Konečni, in press).

Discussion

Collectively, the sixteen male, mostly European, painters represented in this sample—despite working in a variety of styles, and in the early decades of the 20th century—were generally able to communicate intuitively with the present-day Californian young adults of both genders about

