



# The “Golden Woman:” An Exploratory Study of Women’s Proportions in Paintings<sup>1</sup>

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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; Hoegen, 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 literature<sup>3</sup>, 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).<sup>4</sup> 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).<sup>5</sup>

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

female youth and attractiveness (reproductive fitness) by using the language of rather subtle facial and bodily proportions. The small size of the sample has not obscured these facts.

When the painters depicted young female figures, they tended also to impart a considerable physical attractiveness to them. The most attractive figures differed from the rest of the sample in three of the four proportions that were measured in this study. Although one might perhaps be able to identify other proportions that would distinguish the most attractive members of the sample from the older and less attractive young members, it is notable that two of the three distinguishing proportions—the facial cross and the body bi-section at the navel—are golden sections that have been an important part of the classical ideas of youth, health, fertility, and beauty and used as such in Greek statues. Two thousand years later, painters in the sample continued to give life to these ideas through their use of female proportions. The fact that their meaning is correctly communicated another hundred years later to viewers mostly unschooled in the arts testifies to their being an aspect of accumulated human wisdom.

With regard to the facial measurements, the mean of the facial cross was at the golden section for the figures judged the most attractive, and though not significantly different from the mean for the rest of the sample (0.58), there was significantly less variability. In contrast, the facial bi-section at eyebrows was not differentially related to attractiveness in either the mean or variability.

These results are in agreement with those reported by Cunningham (1986). Although Cunningham did not calculate the ratios of the facial measurements (see Footnote 3), one sees, in his Table 2 (p. 929), a non-significant correlation of .08 between "forehead height, eyebrow to hairline" (which is related to the present FBE) and the attractiveness ratings given to photographs of young women by college seniors; on the other hand, the highest cor-

relation of a measurement and rated attractiveness in the same Table is .50 for "cheekbone width" (which is related to the present FC).

Turning to the two bodily proportions, in the case of the body bi-section at the navel, the most attractive figures differ from the rest of the sample in (a) their mean being at the ideal, the golden section, (b) it being significantly different from the mean for the rest of the sample (0.76), and (c) their having a significantly smaller BBN variability than the rest of the sample. The second relationship, the waist-to-hip ratio, distinguishes the most attractive figures from the rest of the sample only in the significantly smaller WHR variability, since both subgroups have their mean WHRs in the ideal range (0.69).

In his seminal paper on the role of the WHR in the adaptive significance of female physical attractiveness, Singh (1993) hypothesized that the WHR was more primary and culturally invariant than the facial proportions: Nothing in the present data contradicts that statement. What the present research suggests, however, is that it might be very worthwhile in the future to pay special attention to the relationship between the body bi-section at the navel and the waist-to-hip ratio. Both sets of measurements are apparently associated with female beauty: But because it depends on estrogen-related accumulation and distribution of fat (e.g., Björntorp, 1991; Rebuffé-Scrive, 1987), the WHR is directly related to health and fertility (e.g., Radke-Sharpe, *et al.*, 1990; Singh, 1993), and therefore undergoes at least two major changes in a woman's lifetime, whereas the BBN should be stable from very early in life. Is it possible that a BBN at the golden section in a pre-pubescent girl might be predictive of a healthy WHR in the 0.70 region by the time she has reached child-bearing age? Is bone growth related to the pattern of fat accumulation? How are they together and individually affected by the nutritional and dietary factors?

With regard to the relationship of the present data to those reported in Konečni



(in press), it is of interest that the most attractive female figures, characterized in part by the use of golden sections in both their facial and bodily proportions, were not placed into pictorial settings that were further embellished by a comparatively high number of golden sections. Depending on how one thinks of the issue, the most attractive female forms were meant by the painters either to stand out from the average settings or to improve them by their presence. Such questions, like the aforementioned ones, can be productively explored in the future psycho-aesthetic and socio-biological studies that will follow the present exploratory work.

## Notes

1. For reprints, please write to Vladimir J. Konečni, Department of Psychology, University of California at San Diego, La Jolla, CA 92093. A brief version of this paper, entitled "The 'golden woman' in 20th-century art," was presented by Laney E. Cline and Vladimir J. Konečni at the XVth Congress of the International Association of Empirical Aesthetics, New York City, August 2000.
2. Laney E. Cline is currently a graduate student at the School of Social Work, Columbia University, New York City.
3. Cunningham (1986) examined the correlation of many female facial measurements (obtained from the yearbook and beauty-pageant photographs), including the length of the face, the height of the forehead, and the cheekbone width, to judged attractiveness—but did not, unfortunately, examine or report the *ratios* of the measurements (such as the "facial cross") that are of interest in the present paper.
4. It might be noted that in a study using composites of faces, the composite of a small number of the most attractive faces was found to be more attractive than the composite of all the faces in the sample (Perret *et al.*, 1994).
5. The two Child figures are of a pre-pubescent and of an early-pubescent girl, respectively. This finding, rather than being anomalous, is instead quite in line with the current socio-biological literature that has consistently identified the important role played by neoteny in physical attractiveness and sexual selection (e.g., Jones, 1995; Katz, 1999).

## References

- Arnheim, R. (1966). A review of proportion. In G. Kepes (Ed.), *Module, proportion, symmetry, rhythm*. New York: Braziller.
- Berlyne, D. E. (1971). *Aesthetics and psychobiology*. New York: Appleton-Century-Crofts.
- Björntorp, P. (1991). Adipose tissue distribution and function. *International Journal of Obesity*, 15, 67–81.
- Boselie, F. (1992). The golden section has no special attractiveness! *Empirical Studies of the Arts*, 10, 1–18.
- Bouleau, C. (1963). *The painter's secret geometry: The study of composition in art*. London: Thames and Hudson.
- Buss, D. M. (1994). *The evolution of desire: Strategies of human mating*. New York: Basic Books.
- Cunningham, M. R. (1986). Measuring the physical in physical attractiveness: Quasi-experiments on the sociobiology of female facial beauty. *Journal of Personality and Social Psychology*, 50, 925–935.
- Fechner, G. T. (1876). *Vorschule der Aesthetik (A Primer of Aesthetics)*. Leipzig: Breitkopf & Haertel.
- Gangestad, S. W., & Thornhill, R. (1997). Human sexual selection and developmental stability. In J. A. Simpson & D. T. Kenrick (Eds.), *Evolutionary social psychology*. Mahwah, NJ: Lawrence Erlbaum Assoc.
- Grammer, K., & Thornhill, R. (1994). Human (*Homo sapiens*) facial attractiveness and sexual selection: The role of symmetry and averageness. *Journal of Comparative Psychology*, 108, 233–242.
- Green, C. D. (1995). All that glitters: A review of psychological research on the aesthetics of the golden section. *Perception*, 24, 937–968.
- Hersey, G. L. (1996). *The evolution of allure: Sexual selection from the Medici Venus to the Incredible Hulk*. Cambridge, MA: MIT Press.
- Hoeghe, H. (1995). Fechner's experimental aesthetics and the golden section hypothesis today. *Empirical Studies of the Arts*, 13, 131–148.
- Johnston, V. S. (2000). Female facial beauty: The fertility hypothesis. *Pragmatics and Cognition*, 8, 107–122.
- Johnston, V. S., & Franklin, M. (1993). Is beauty in the eye of the beholder? *Ethology and Sociobiology*, 14, 183–199.
- Joiner, T. E., Jr., Schmidt, N. B., & Singh, D. (1994). Waist-to-hip ratio and body dissatisfaction among college women and men: Mod-

- erating role of depressed symptoms and gender. *International Journal of Eating Disorders*, 16, 199–203.
- Jones, D. (1995). Sexual selection, physical attractiveness, and facial neoteny. *Current Anthropology*, 35, 723–748.
- Katz, B. F. (1999). Evolution, the invisible artist. *Empirical Studies of the Arts*, 17, 101–120.
- Konečni, V. J. (1991). Portraiture: An experimental study of the creative process. *Leonardo*, 24, 325–328.
- Konečni, V. J. (1997). The vase on the mantelpiece: The golden section in context. *Empirical Studies of the Arts*, 15, 177–208.
- Konečni, V. J. (1999). The “golden section” and XXth-Century art. *Proceedings of the International Conference “XXth-Century Art: Achievements, Traditions, and Innovations,”* the Hermitage Museum, St. Petersburg, Russia, 219–221.
- Konečni, V. J. (2000). The golden section: elusive, but detectable. Unpublished manuscript, University of California, San Diego.
- Konečni, V. J. (in press). The golden section in the structure of 20th-century paintings. *Rivista di psicologia dell'Arte*.
- Langlois, J. H., & Roggman, L. A. (1990). Attractive faces are only average. *Psychological Science*, 1, 115–121.
- McManus, I. C. (1976). Scrotal asymmetry in man and in ancient sculpture. *Nature*, 259, 426.
- Møller, A., & Thornhill, R. (1998). Developmental stability and sexual selection: A meta-analysis. *American Naturalist*, 151, 174–192.
- Perret, D. I., May, K. A., & Yoshikawa, S. (1994). Facial shape and judgments of female attractiveness. *Nature*, 368, 239–242.
- Radke-Sharpe, N., Whitney-Saltiel, D., & Rodin, J. (1990). Fat distribution as a risk factor for weight and eating concerns. *International Journal of Eating Disorders*, 9, 27–36.
- Rebuffé-Scrive, M. (1987). Regional adipose tissue metabolism in men and in women during menstrual cycle, pregnancy, lactation and menopause. *International Journal of Obesity*, 11, 347–355.
- Scheib, J. E., Gangestad, S. W., & Thornhill, R. (1999). Facial attractiveness, symmetry and cues of good genes. *Proceedings of the Royal Society of London, B*, 266, 1913–1918.
- Singh, D. (1993). Adaptive significance of female physical attractiveness: Role of waist-to-hip ratio. *Journal of Personality and Social Psychology*, 65, 293–307.
- Singh, D. (1994). Ideal female body shape: Role of body weight and waist-to-hip ratio. *International Journal of Eating Disorders*, 16, 283–288.
- Singh, D., & Luis, S. (1995). Ethnic and gender consensus for the effect of waist-to-hip ratio on judgment of women’s attractiveness. *Human Nature*, 6, 51–65.
- Thornhill, R. (1993). The allure of symmetry. *Natural History*, 102, 30–37.
- Thornhill, R., & Gangestad, S. W. (1999). The scent of symmetry: A human sex pheromone that signals fitness? *Evolution and Human Behavior*, 20, 175–201.
- Thornhill, R., & Grammer, K. (1999). The body and face of woman: One ornament that signals quality? *Evolution and Human Behavior*, 20, 105–120.

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## Appendix

### *The Sample of 24 Paintings*

No.	Painter	Painting	Year	P/L <sup>a</sup>	Ratio <sup>b</sup>
1.	Jean Vuillard	<i>Mother and Child</i>	1900	"Square"	0.96
2.	Lyov Bakst	<i>The Beautiful Harem Girl</i>	1910	P	0.61
3.	Jean Vuillard	<i>Mme Hessel Seated</i>	1910-12	P	0.78
4.	Lyov Bakst	<i>The Punishment of Cupid</i>	1910?	Ellipse	0.89
5.	Lyov Bakst	<i>Sketch of a Woman's Dress</i>	1912	P	0.65
6.	August Macke	<i>Vendor With Pitchers</i>	1914	P	0.77
7.	Amadeo Modigliani	<i>Girl with Braids</i>	1917	P	0.74
8.	John Duncan	<i>The Kelpie</i>	1917?	L	0.75
9.	Juan Gris	<i>Portrait of Mme Lipshutz</i>	1918	P	0.64
10.	Amadeo Modigliani	<i>Reclining Nude</i>	1919	L	0.62
11.	Amadeo Modigliani	<i>Portrait of Lunia Czechowska</i>	1919	P	0.70
12.	John Duncan	<i>Baba &amp; Billy</i>	1920	P	0.75
13.	Cristóbal Ruiz	<i>Portrait of His Daughter in a Corridor</i>	1923	P	0.71
14.	Cristóbal Ruiz	<i>Interior</i>	1923?	"Square"	0.97
15.	Salvador Dalí	<i>Girl's Back</i>	1925	P	0.71
16.	Pablo Picasso	<i>Woman Writing</i>	1932	P	0.63
17.	John Duncan	<i>Phlegethon</i>	1935?	L	0.66
18.	Morris Hirshfield	<i>Beach Girl</i>	1937-39	P	0.61
19.	Victor Brauner	<i>Nude and Spectral Still Life</i>	1939	P	0.79
20.	Max Ernst	<i>Napoleon in the Wilderness</i>	1941	P	0.81
21.	Max Beckmann	<i>Woman with a Parrot</i>	1946	P	0.64
22.	George Tooker	<i>The Subway</i>	1950	L	0.50
23.	Andrew Wyeth	<i>Chambered Nautilus</i>	1956	L	0.51
24.	Paul Delvaux	<i>The Mirage</i>	1967	L	0.62

<sup>a</sup> P = "portrait" orientation; L = "landscape" orientation; "Square" = near-square.

<sup>b</sup> Ratio of the shorter to the longer picture dimension.