# Symmetry in Nature and Faces: The Relationship of Beauty Perception and the Role of the Golden Ratio

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## ABSTRACT

This paper delves into aesthetic perceptions, researching the intrinsic relationship between beauty and the golden ratio in flowers and faces. The literature review navigates the historical, mathematical, and biological underpinnings of beauty's subjectivity and its connection to the golden ratio. Utilizing a three-stage modified Implicit Association Test (IAT) methodology, involving images of flowers and faces adhering or deviating from the golden ratio, the study examines subconscious preferences among 75 participants. Participants were tasked with rapid selections between pairs of flower and facial images, revealing their unconscious aesthetic inclinations. Approximately 45.3% of the sample exhibited a consistent affinity for symmetrical and golden ratioed features, showcasing an unconscious recognition of the golden ratio. Correlation analyses (pearson correlation coefficient of 0.543) indicate a strong preference for symmetrical flowers leading to a larger preference for symmetrical faces, and vice versa, emphasizing the interplay between floral and facial aesthetics. However, a considerable segment displayed a divergence, favoring flowers and faces lacking the golden ratio, illuminating diverse aesthetic choices. These findings highlight the profound impact of visual associations and humanity's innate attraction to the golden ratio, indicating an inherent inclination towards this geometric proportion.

## Introduction

Hume's assertion that beauty is inherently subjective and resides solely within the contemplating mind (1757) has been a focal point in philosophical discourse for centuries. Augustine, in his work De Veritate Religione (1953), delved into the intriguing question of whether objects are inherently beautiful or if their beauty arises from the pleasure they evoke. Despite the pervasive subjectivity, attempts to quantify beauty have historically gravitated towards tools such as the golden ratio, an ancient mathematical concept dating back to Euclid in 300 BCE.

### The Golden Ratio: Mathematical Representation and Aesthetic Standards

Termed "phi φ," the golden ratio, akin to pi in significance, has various appellations - the golden mean, and the golden section, among others (Dunlap). Defined mathematically as an irrational number, $(1+\sqrt{5})/2$, this geometric proportion has transcended millennia and was originally expounded upon by Euclid, the progenitor of geometry. Central to the golden ratio are proportions, elucidating not just relative relations between quantities but specific mathematical equities exemplified by "nine is to three as six is to two" (Livio, 2002). This mathematical construct has been foundational in articulating aesthetically pleasing proportions across disciplines like art, science, and engineering, consequently introducing quantifiable standards to assess beauty (Craciun, 2019).

Beauty's Influence in Nature: Flowers and Faces

The unexplained allure of flowers to humans surpasses mere practicality, as flowers have been revered for their aesthetic allure throughout history. From an evolutionary standpoint, flowers employ aesthetic traits to engage humans in nurturing them, forming a mutually beneficial relationship. Studies demonstrate the neural activation triggered by flower visuals, engaging sensory-motor, viscera-motor, and affective cerebral circuits, culminating in a stimulating perceptual experience (Huss et al., 2018). The positive correlation between human emotions and flowers is substantiated by studies revealing the association of flowers with positive emotions and the elicitation of genuine smiles in individuals (Haviland-Jones, 2005).



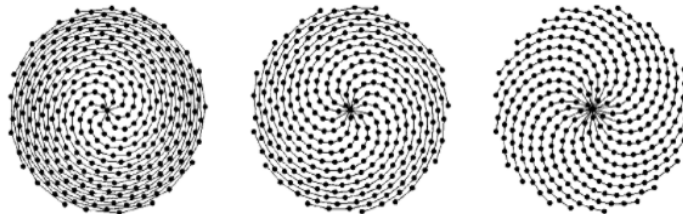**Figure 1.** Fibonacci Seeds (Naylor, 2002)



**Figure 2.** Fibonacci Series in Seeds (Naylor, 2002)

Nature's embodiment of the golden ratio is prominently showcased in flowers, evident in the arrangement of leaves, seeds, spirals, and petals. Particularly noteworthy is the sunflower, wherein the seeds' spiral pattern exemplifies the golden ratio. Simulations conducted by Michael Naylor, a mathematics professor, demonstrate the consistent spiral arrangements aligning with the golden ratio, often following the Fibonacci sequence as shown in Figure 1 and 2 (Omotehinwa). This sequence, observed in flower petals, is exemplified in various floral types, reinforcing the attraction of individuals towards flowers exhibiting the golden ratio in their petal counts. John Gardiner's proposition regarding the ubiquity of the golden ratio in nature aligns with the human perception of beauty, correlating it with the fundamental consciousness structure (Gardiner, 2012).

The pursuit to quantify facial attractiveness has led researchers to explore proportional measures aligning with the golden ratio in facial features. Symmetry, posited as a signal of mate quality, influences facial

attractiveness, corroborating evolutionary theories (Rhodes, 1998). Studies emphasizing the correlation between facial symmetry and attractiveness reinforce the notion that symmetrical faces are perceived as more appealing, impacting human mate selection (Rhodes).

The Preference of the Golden Ratio

The neurological and psychological underpinnings of perceiving beauty are rooted in specific brain regions associated with memory encoding and reward. Research elucidates the role of prefrontal areas in perceiving beauty through various magnetoencephalography studies, revealing a selective activation when perceiving objects categorized as "beautiful" (Propakis et al.). Despite cultural influences, research suggests a universal subconscious standard for beauty, where adherence to ratios such as the golden ratio manifests in architectural and artistic endeavors, even influencing facial plastic surgeries striving to achieve these proportions with remarkable precision (Propakis et al.).

## Methodology

This study employed a modified version of the Implicit Association Test (IAT) as the primary method for data collection of subconscious and quick choices. Developed by Anthony Greenwald in 1998, the IAT operates by concealing conscious access while unveiling unconscious attitudes, automatic preferences, and hidden biases. It serves as a valuable tool for eliciting immediate, genuine responses without allowing room for deliberate contemplation or biased adjustments to societal expectations. By imposing stringent time limits for responses, the IAT prompts participants to respond instinctively, thus revealing attitudes and beliefs that might otherwise remain undisclosed, as highlighted by Project Implicit at Harvard. The relevance of the Implicit Association Test in this research lies in its ability to discern unconscious preferences concerning facial and floral aesthetics, particularly adherence to the golden ratio. Notably, other researchers, such as Mariella Pazzaglia in her work on art appreciation, have similarly utilized the IAT to explore implicit and explicit attitudes towards aesthetic preferences. Pazzaglia's investigation into the implicit and explicit attitudes of art experts and non-experts towards paintings echoes the nature of this study, albeit in a different domain, emphasizing the exploration of implicit preferences regarding visual stimuli.

This study adopted a three-stage approach facilitated through testable.org. The first stage involved fundamental questionnaires encompassing demographic information alongside inquiries delving into personal ideals and perceptions of beauty. These questions aim to unveil biases and assess how personal inclinations might influence preferences, providing valuable insights into individual biases and their impact on choices related to facial and floral aesthetics. Subsequent stages involved the selection of preferred images—flowers in the second stage as shown in Figure 3 and faces in the third as shown in Figure 4—where participants were tasked with choosing between two images, one adhering to the golden ratio and the other not. Participants were instructed to select the images they found most aesthetically pleasing, unaware of the specific study's focus on aesthetic preferences linked to the golden ratio. Each stage incorporated multiple questions and stimuli to comprehensively evaluate participants' implicit preferences regarding visual stimuli.This methodology was designed to understand the implicit and visual associations between the golden ratio and aesthetic preferences in facial and floral features, providing valuable insights into subconscious biases and preferences within a diverse population.

**Figure 3.** Some of the flowers participants chose between during stage 2 of the IAT.
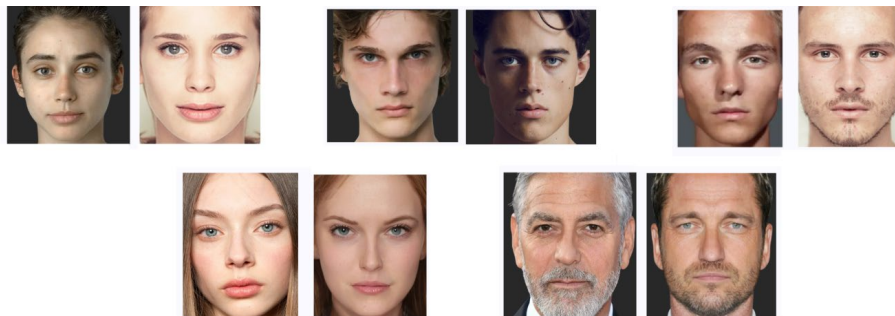


**Figure 4.** Some of the faces participants chose between during stage 3 of the IAT (Left faces are asymmetrical, right faces are symmetrical)

## Results

After collecting a sample of 75 people's responses to the experiment, the percentages of golden ratioed faces and flowers chosen were calculated per participant. For analytic purposes, the samples were categorized between adverse and preferred. Adverse was the label given to the cluster of people who chose less than 50% of flowers or faces and preferred 50% or greater quantities as presented in Table 1. The bolded clusters represent the clusters of the sample population that recognized the golden ratio and associated the golden ratio of flowers and faces. These clusters were mapped to show spread on the scatter plot shown in Figure 5. As shown in Table 1 and Figure 5 about 45.3% of the sample were able to consistently associate the golden ratio and symmetry of faces and flowers in their preference for beauty.

**Table 1.** Frequencies of Adverse and Preferred Clustering of Sample Population.

|  | Golden Ratioed Faces Adverse | Golden Ratioed Faces Preferred |
|---|---|---|
| Golden Ratioed Flowers Adverse | **6** | 5 |
| Golden Ratioed Flowers Preferred | 36 | **28** |
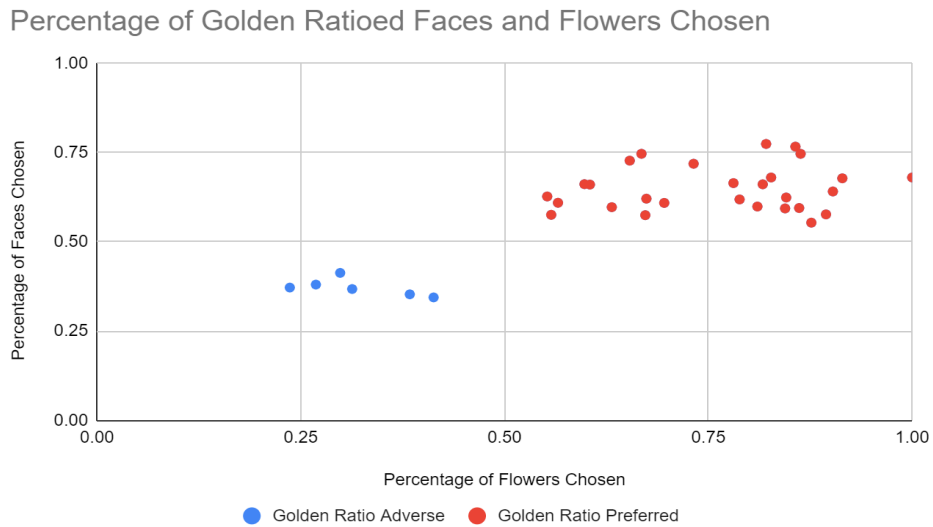
**Figure 5.** Scatter Plot of Visual Recognition of Golden Ratio and Symmetry

**Table 2.** Demographic Data for Each Adverse and Preferred Clustering of Sample Population

|  | Golden Ratioed Faces Adverse | Golden Ratioed Faces Preferred |
|---|---|---|
| Golden Ratioed Flowers Adverse | - Male: 50%<br>- Female: 50%<br>- Avg Age: 25.3 | - Male: 60%<br>- Female: 40%<br>- Avg Age: 35.8 |
| Golden Ratioed Flowers Preferred | - Male: 50%<br>- Female: 50%<br>- Avg Age: 31.3 | - Male: 67.8%<br>- Female: 32.2%<br>- Avg Age: 33.357 |

**Table 3.** Common Themes and Quotes from Beauty Standard Open Response Questions

|  | Golden Ratioed Faces Adverse | Golden Ratioed Faces Preferred |
|---|---|---|
| Golden Ratioed Flowers Adverse | Beauty Standards within People:<br>"Though I found conventional attractiveness important, a person with a good personality matters the most."<br><br>"....Usually, I find women who are intelligent with a strong personality more attractive." | Beauty Standards within People:<br><br>"Their unicity. Everyone has different traits, which for someone are beautiful and for others not…. That's the "exterior", but in reality what makes a person beautiful is their personality." |

| | | "Honestly, personality more than anything." |
|---|---|---|
| | "that they are kind and positive by nature, it usually shines through their face." | "Confidence." |
| | "Confidence." | Beauty Standards within Flowers: "They can have exotics shapes and wonderful colours and smells." |
| | Beauty Standards within Flowers: "Flowers are beautiful because they have unique colors and fragrances and they have different types of varieties." | "Flowers are beautiful.Their vibrant colors and intricate patterns can captivate our senses and evoke feelings of joy and delight." |
| | "Flowers are beautiful because they have nice vibrant colors and unique smells that make the world less dull." | "They are beautiful because of their colour and structure." |
| | "The delicacy makes them beautiful to me." | |
| Golden Ratioed Flowers Preferred | Beauty Standards within People: "A person's heart makes them beautiful." "Their kindness." "Personality and perception make a person beautiful." "Their hearts. The way they treat other people and if they're honest." "Their personality more than anything makes a person beautiful…" Beauty Standards within Flowers: "I have always found flowers beautiful. I like their vibrant colors and their shapes.// "The vibrant colours and symmetry of them makes them beautiful." | Beauty Standards within People: "Surgery, warm heart, comfort" "Combination of factors like smooth skin, warm smile, pretty eyes, and symmetry." "Symmetry, proportionality, clear complexion, well-groomed features, and healthy body attributes are often associated with physical beauty…." "Aesthetically pleasing." ".... Clear, glowing, youthful skin is …slim build (pronounced waist for females, with good muscle tone for males)." "Beautiful eyes and mouth." Beauty Standards within Flowers: "Flowers come in a wide array of vibrant colors, intricate shapes, and |

| | | |
|---|---|---|
| | "Flowers are in a variety of colours that are very pleasant to the eyes and their shape is in extraordinary coordination." | delicate textures. These visual qualities can be visually pleasing and captivating to many people." |
| | "They are colorful,well organized and come in varying shapes." | …They all have perfect symmetry though and patterns in how the petals have grown" |
| | "Flowers are very beautiful, they make the kitchen look fresh, and brighten it up." | "Their color and arrangement of the flower parts contributing to their shape" |

## Analysis & Discussion

The results of the experiment unveiled a compelling correlation in the perception of the golden ratio between flowers and faces. Among the 75 participants surveyed, 33 individuals (44%) demonstrated a subconscious preference for symmetrical and golden ratioed faces, while 34 participants (45.3%) were able to visually associate golden ratioed flowers and faces regardless of their personal preferences. Various correlation analyses and paired t-tests were conducted on the percentages of chosen faces and flowers within the sample, as detailed in Table 4. The Pearson correlation test indicated a significant relationship between the preference for golden ratioed faces and golden ratioed flowers. This suggests a strong inclination toward symmetrical flowers leading to a heightened preference for symmetrical faces, and vice versa.

In Table 3, the results highlighted that among the respondents questioned on "what makes a person beautiful," approximately 14 out of 34 individuals emphasized the importance of symmetry and the presence of favorable facial features. Furthermore, under the query "What do you think makes someone's face beautiful?" about 13 out of 34 participants believed it was related to the proportions of facial features. These findings indicate that nearly 50% of individuals acknowledge the significance of perceiving the golden ratio on a person's face, indicating an unconscious pursuit of such qualities.

An analysis of participant responses reveals a discernible trend: individuals displaying a heightened recognition of the golden ratio tend to prioritize physical appearance in their descriptions, emphasizing its importance. Conversely, those less attuned to recognizing faces adhering to the golden ratio often exhibit a preference for personality traits over physical attributes.

**Table 4.** Statistical and Correlation Test Results

| Statistic and Correlation Test | Test Result and Statistic |
|---|---|
| Paired T-Test | P-value: 0.0001 |
| Pearson Correlation Test | Test Statistic:  0.543<br>P-value: 0.182 |
| Point-Biserial Correlation | Test Statistic: 0.389<br>P-value: 0.135 |

## Limitations

Recognizing the inherent limitations of implicit association tests is essential in this context. Much of the data is self-reported and self-facilitated, allowing for potential human and environmental factors that could influence the accuracy of the experiment. The initial phase of the experiment relied on self-reported surveys, introducing the possibility of response bias and inaccuracies. Enhancing the precision of the data could have been accomplished by including inquiries specifically targeting preferences regarding appearance versus personality. It's important to note that the survey encountered difficulties in achieving a balanced racial representation among participants, potentially impacting the study's conclusions. Additionally, the inclusion of celebrity faces may have introduced biases for certain individuals, requiring careful consideration.

## Conclusion

This survey emphasizes individuals' subconscious ability to discern and favor symmetry, evident in their inclination towards symmetrical flowers and faces as aesthetically pleasing. Symmetry's significance in mate selection, indicating phenotypic and genetic quality, has been well-documented (Perrett, 1999). Previous studies, such as those conducted by Makin et al., reinforce the association between symmetry and beauty, using the Implicit Association Test (IAT) to gauge implicit aesthetic preferences without explicit judgments. Makin's experiments revealed participants' implicit preferences for specific visual patterns, highlighting the IAT's efficacy in probing implicit preferences. Similarly, Jacobsen's research mimicked these findings, emphasizing positive ratings for symmetry despite its potential to reduce pattern complexity. This collective body of work underlines symmetry's profound impact on aesthetic preferences, shedding light on implicit recognition and preference for symmetrical patterns in visual stimuli. The IAT emerges as a valuable tool in unveiling implicit aesthetic inclinations, contributing to a deeper understanding of human perceptions of symmetry in defining beauty and preference.

The study suggests that while some individuals subconsciously recognize symmetry in flowers and faces, inherent variations in human preferences lead others not to. Rhodes' research aligns with these findings, illustrating increased attractiveness associated with facial symmetry and decreased attractiveness with asymmetry. Participants here displayed a preference for symmetrical traits in both flowers and faces, emphasizing symmetry's pivotal role in their perception of beauty. However, studies showcasing varying responses to symmetry, such as Zaidel's work, highlight the brain's capacity to perceive beauty in both symmetrically and asymmetrically structured stimuli. This study echoes the understanding that symmetry isn't the sole criterion for beauty assessment, with some emphasizing character evaluation.

This exploration study elucidates that while the golden ratio symmetry influences perceptions of beauty for some, multiple factors contribute significantly to aesthetic judgments. Industries catering to preferences aligned with the golden ratio, like plastic surgery and photo manipulation tools, might find traction among certain individuals. Nevertheless, this study proves the multifaceted nature of beauty assessments, encompassing traits beyond symmetry. This nuanced comprehension highlights the complexity of human preferences in perceiving beauty, acknowledging the interplay of multiple factors beyond mere symmetrical features.

## Acknowledgments

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