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Research Article

Cognitive Study on Illusion Using Golden Ratio for Apparel Design

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Abstract

The study aims to identify the illusive design that can be effectively implemented on apparel to accommodate individuals with varying body proportions. In addition to the implementation of illusive designs on apparel, the study also delves into the concept of fashion illusion from a cognitive science perspective. According to the study, it is suggested that the golden ratio (1.618) is the ideal number for accurately perceiving dresses without any optical illusions. A structured questionnaire was developed to determine the effect of the golden ratio on creating a fine-looking or illusive appearance, as illusion is sometimes preferable for different nonstandard body shapes. Furthermore, this study recommends that illusion in fashion should be considered a physical state rather than a so-called mental state, aligning with cognitive science. It asserts that the concept of "illusion" itself does not truly exist.

Keywords: Apparel design; Illusion; Golden ratio; Cognition

Introduction

The concept of design emerges from a cognitive process that combines psychological, physiological, and neurotransmission states in observers. Illusion, when it comes to apparel design, is also a state that can be understood through this cognitive process. To establish a universal standard for apparel design and the optical illusions created by clothing, the golden ratio provides a suitable and practical approach. The dimensions of length and width play a crucial role in determining our body's appearance in any garment. Considering the variations in size and shape among individuals due to physical, biological, and environmental factors, there are certain key measurements in dressmaking that apply effectively to all body sizes. Among these measurements, the length-to-width ratio of a dress prominently contributes to its beauty and compatibility with the wearer's body.

As a result, the visual aspect of a garment's front view is greatly influenced by the ratio between its length and width in apparel design. This study seeks to investigate how this ratio can be determined and what defines an optimal ratio. The renowned "golden ratio "has been extensively examined and holds the key to this inquiry. However, it is essential to thoroughly examine the practical application of the golden ratio and examine the illusions that can arise from alternative ratios in apparel design. Such an investigation necessitates a comprehensive cognitive process and an extensive study within the context of the Indian subcontinent.

While countries like Indonesia, the Philippines, China, Bangladesh, Cambodia, Vietnam, and India serve as prominent apparel production nations, they lag behind in apparel design. Therefore, it is required to generate momentum for conducting creative and design-oriented studies within this sector. In contrast to the Indian subcontinent, nations like the Hong Kong, France, United States, United Kingdom, and Italy have played a pivotal role in driving the progress of fashion design. These countries have made noteworthy contributions to the development and innovation within the field of fashion. They have established diverse educational systems, including web-based fashion education [1]. Consequently, it is imperative

for the Indian subcontinent to catch up in this aspect and conduct further research to establish advanced technology in apparel design. For instance, while Western countries have already embraced three-dimensional body scanning technology as a replacement for traditional manual sketching methods, the subcontinent lags in incorporating such cutting-edge advancements [2].

Hence, precise empirical research on design is indispensable to unlock the full potential of the apparel sector. In the Indian subcontinent, significant efforts have been made to enhance the apparel industry, excluding research focused specifically on apparel design. For example, work on cutting technology is a notable contribution to textile technology, which influences apparel design significantly [3]. However, fashion technology lacks similar advancements. From this standpoint, this study contributes to the educational, commercial, and physiological betterment of fashion design in Bangladesh and the broader subcontinent.

Furthermore, design stands as the foremost quality of a product that influences a person's initial attraction to garments. It is through design that individuals distinguish themselves from others in society, with considerations of texture, performance, comfort, and other factors following suit. The Indian subcontinent, given its amalgamation of genes from various cultures such as British, Portuguese, Dutch, and others that arrived for business purposes, exhibits a wide range of body structures. Consequently, conducting a study on apparel design, particularly focusing on illusions that aid individuals in selecting garments that complement their unique body structures, becomes crucial.

While Apeagyei's research presented a standard body shape and size to resolve the dilemma of determining the perfect size or shape, it did not analyze the golden ratio [4]. Similarly, research investigating illusions created by apparel design for different body shapes and the underlying cognitive processes remains largely unexplored, despite body shape and image occupying a crucial position in fashion consumption [5]. Fashion design is influenced by various factors such as culture, history, and the psychological process.

Kobayashi et al. [6] discussed in his theory about the stepwise shape optimization as well as topology for designing and other researcher works on other aspects [7]. Tailor and Newton [8] emphasized the need for a standardized model of psychological states to establish universal measurements for apparel design worldwide. While many related research works have been conducted on various facets of design, there was a lack of specific focus on the mental aspects of illusive design and the exertion of the golden ratio. The availability of studies dedicated to exploring these particular areas is limited [7].

Previous research has delved into the utilization of the golden ratio in apparel design. Akhtaruzzaman et al. [9] emphasized the widespread incorporation of the golden ratio in various domains such as design, engineering, nature, and architecture [8]. Kazlacheva [10] and Kazlacheva [11] investigated the application of the Golden Square and Pythagorean tiling's to create visual appeal designs in apparel [9,10]. Kazlacheva and Ilieva [11] showcased a creative design method using the golden square and golden spiral [11]. Additionally, Kazlacheva [12] and Kazlacheva [13] demonstrated how Fibonacci squares and circles could be utilized to achieve harmonious and aesthetic designs in apparel [12-14].

A study conducted by Sudha [15] investigated the implementation of the Fibonacci square, golden circle, and golden spiral in the realm of apparel design [15]. Ilieva [16] explored the using of the golden spiral, golden rose, and golden rectangle to create decorative bands [16] while Kazlacheva [13] utilized the golden rose for aesthetic designs on apparel [17]. Kazlacheva [18] expanded the application of the golden ratio to pattern making [18] and Nguyen [19] introduced golden ratio's relevance to origami for apparel design [19].

To understand the origins of design and illusion, cognitive processes related to the human brain have been investigated. The brain serves as the central processing unit for the body, receiving information from the sensory organs. Studies have shown the connection between art, design, and neuroscience [20,21]. However, research specifically focused on fashion design and illusion remains limited. Sullivian P [22] has analyzed the psychology of art but not specifically on fashion or illusion [22] whereas Abuhamded S [23] illustrated the different personality of artist not exactly designer [23].

Gully [24] and Csanák [25] explored the cognitive processes and ecological aspects of apparel design, highlighting the connection between different neural regions [24,25]. Yet, comprehensive studies on the cognitive process of illusion in apparel design are lacking. Zaidel [26] suggested that art stems from an evolutionary process involving various neural regions of the brain related to cognitive science [26] but a deeper understanding of the relationship between art and the brain is still needed [27].

In summary, this study aims to identify suitable illusive designs based on the golden ratio for diverse individuals. Additionally, it seeks to explore the physiological connection between illusion and the golden ratio in apparel design. Such research on the golden ratio can contribute to empirical studies and practical applications, such as Gait Recognition technology [28].

Material and Methods

This study employed a combined methods approach, to utilize both qualitative and quantitative research methods, in order to achieve its objectives. Data were gathered from primary and secondary sources. The Secondary sources included reports, magazines, books, journals, newspapers, and research documents. Primary data collection involved conducting surveys among targeted respondents, specifically general individuals in shopping malls and offices. A total number of 29 respondents were randomly selected and interviewed using a structured questionnaire to assess the impact of the golden ratio. In order to assess the proportions of the front view of men tucking their shirts into waist belts, a survey was carried out involving 29 participants. The survey focused on measuring the length and width of the two-dimensional view, as depicted in Figure 1, then several people were asked how they look.

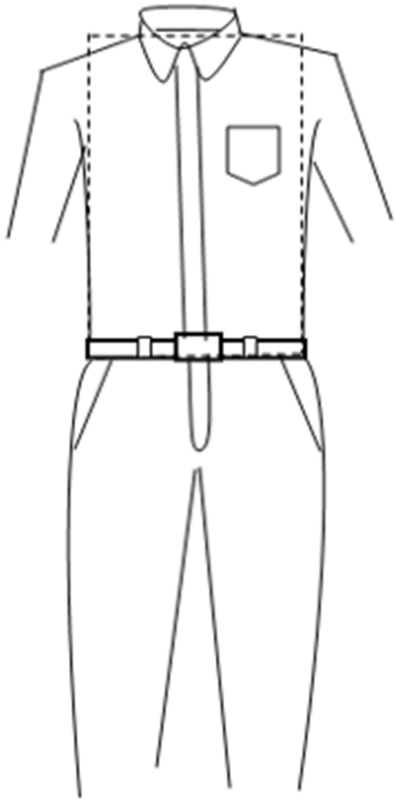

Figure 1: Illusive effect of golden ratio on body top.

In between 25 to 50 aged men only were selected for measurement of the two-dimensional front appearance while their shirts were tucked into the waist belt. From the HPS to the waist belts were considered as length and the entire horizontal appearance in the chest line of the body top was considered as width to figure out the impact of the golden ratio. Thereafter, present people surrounding there were asked to give their opinion on how the respondent looked like having their respective ratios. Different professional places like shopping malls, universities, and garment industries were randomly selected for the survey place.

The primary data obtained from the questionnaire was analyzed using standard statistical methods and presented graphically through line graphs. These graphs visually depict the impact of the golden ratio in apparel, providing a clear illustration. In addition, a thorough literature review was done to comprehend the cognitive process of golden ratios in apparel, specifically exploring the concept of illusions and how they arise as a result of the golden ratio. The phenomenon of illusions and their connection to the golden ratio in the human brain can be explained as follows.

When we observe the reflected light from the overall length and width of a dress in Figure 2, our eyes transmit the sensation to the occipital lobe of the brain, which is responsible for visual processing and perception. This leads to the perception of an optical illusion. Subsequently, the sensation is further transmitted to the parietal lobe of the brain, which plays a role in functions such as calculation (Alam, 2008).

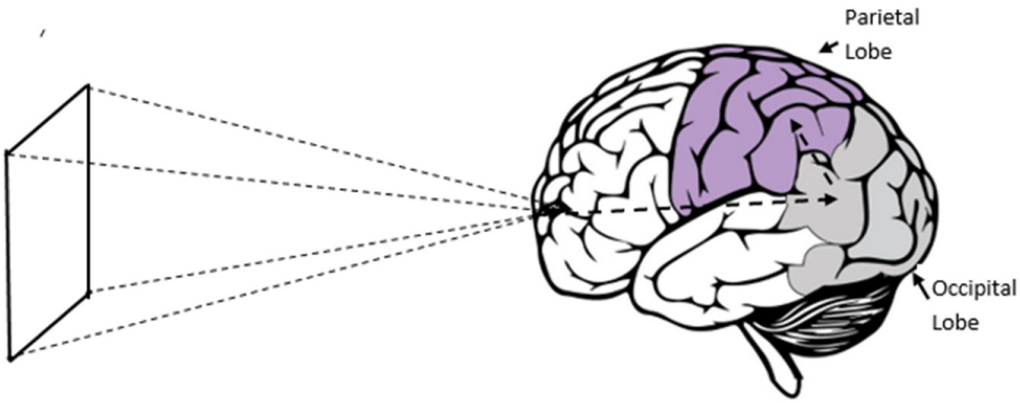

Figure 2: Responsible part of the brain to observe a dimension or shape.

Following that, the study focused on the significance of line effects in creating the perception of slimness or plumpness. Specifically, two types of lines were examined: horizontal lines and vertical lines. These lines play a crucial role in generating illusions of body size. They can be manipulated through various means, including the presence of stripes in fabric weaving or knitting, the inclusion of folds or pleats in garments, the use of accessories like belts, the application of straight-line patterns in printing, and the utilization of contrasting colors through garment wearing or dyeing. It is important to note that color is a result of the interaction between chromospheres or color-bearing groups and light (Sayeed, 2011).

Result and Discussion

Illusion resulting from the ratio of length to width

When it comes to the precise application of the golden ratio, there is no occurrence of illusions, allowing the human brain to make accurate judgments. A person appears smart and formal when wearing a shirt with the hem tucked neatly into the waistband. However, why does this act of tucking create a sense of beauty? Moreover, why does a formal tuck into the waistband create an illusion? The reason lies in the fact that it aligns with the proportions of the golden rectangle. If a person wears a Long Coat, Panjabi, or shirt without tucking it into the waistband, the length

of the golden rectangle becomes more prominent in the overall appearance of the clothing, resulting in a deviation from the perfect golden ratio of 1.618. As a consequence, the resulting ratio exceeds 1.618.

In the provided Table 1, it is evident that the ratios associated with the category of "very good" appearance are quite close to 1.618, with slight variations above or below that value. Similarly, the ratios for the "good" appearance category show a slightly wider distribution compared to the "very good" ratios. The "medium" category exhibits an even greater scattering of ratios than the "good" category, while the "odd" category shows the highest level of scattering among all the categories. Thus, there is a gradual increase in the scattering of ratios from the "very good" to the "odd" category, indicating a departure from the golden ratio of 1.618. And most interestingly, people from 'odd" ratios who wore the waist belt relatively up were judged as less tall despite having the same body height (without apparel) as the people who possess "good" ratios, which is an illusion.

Table 1: Comparative ratios of body front appearances while shirts tuck into the waist belt.

Appearance	V.good	Good	Medium (Moderate Illusive)	Odd (Strongly Illusive)
Ratios	1.6	1.56	1.42	1.37
	1.6	1.61	1.68	1.373
	1.614	1.58	1.49	1.36
	1.58	1.55	1.48	1.43
		1.63	1.77	1.37
		1.68	1.55	
		1.63	1.47	
		1.66	1.49	
		1.68	1.46	
		1.67	1.48	

This pattern is visually represented in the line chart below. The line corresponding to the "very good" ratios aligns closely with the 1.6 axis, indicating a proximity to the golden ratio. The line representing the "good" ratios is slightly below the 1.6 axis, showing a slight deviation from the golden ratio. The line for the "medium" ratios exhibits a greater level of scattering compared to the "good" line. Lastly, the line representing the "odd" ratios appears at the lowest position, indicating the greatest departure from the golden ratio. Hence, the line chart in conjunction with Table 1 demonstrates that ratios associated with "very good" appearances are closer to the golden ratio, while the "odd" and illusive appearances deviate significantly from the golden ratio.

Here, 1.618 and the closest number to 1.618 gives the perfect fittings and eye-soothing appearance so it can be said that this ratio is perfect for the standard size of the body. But for different body shapes and sizes, illusion can be created by increasing or decreasing the ratio. For instance, for a fatty guy, we have to increase the number by only increasing the length of golden rectangles to have appeared him/her as skinny or taller, and on the contrary, for a skinny guy we have to decrease the length of body top which creates the illusion for him/her to be appeared as shorter and fatty, that properly complements their body shape (Figure 3).

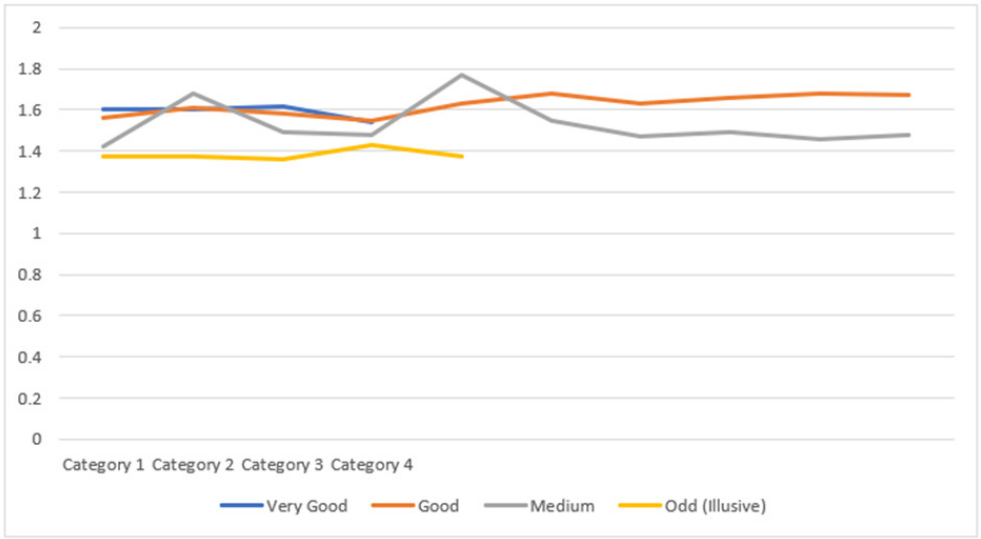

Figure 3: Comparitive ratios of body front appearance while shirts tuck into the waist belt.

After receiving information about the length and width of a dress, the occipital lobe of the brain processes this visual data. Subsequently, the parietal lobe performs calculations to determine the ratio of length to width and makes a judgment regarding the perceived appearance of slenderness or plumpness. In the case of three rectangles depicted in Figure 4, each having the same width but varying lengths, the parietal lobe calculates the length-to-width ratios of these rectangles and generates three distinct outcomes.

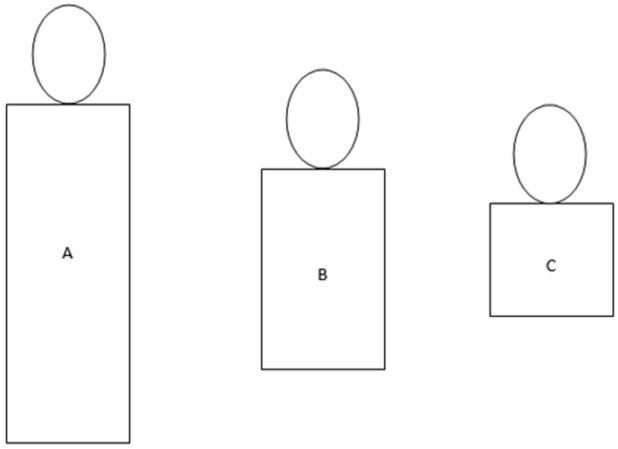

Figure 4: Illusion due to only variation of length keeping the width same.
A. Represents Long Coats, Solid gowns, Panjabi, Kamij, or other dresses (same width but highest length).
B. Represents Formal shirts tucked into waist belts or T-shirts (same width like golden ratio).
C. Represents Blouse or other short Jacket on top (same width but lowest length).

Regarding body B, the occipital lobe processes the length and width information, and subsequently, the parietal lobe determines that the length-to-width ratio is 1.618, which corresponds to the golden ratio. As a result, the brain perceives the dress as flawless, without any illusions, and determines that it possesses favorable measurements.

However, for body C, the length of the dress decreases while maintaining the same width. Consequently, the occipital lobe receives the length and width information, and the parietal lobe calculates the length-to-width ratio, yielding a value lower than 1.618. Consequently, the human brain perceives the dress or the wearer as broader or plump due to this lower ratio.

Similarly, if the parietal lobe receives a length measurement for a dress that is greater than that of body A, while keeping the width constant, it calculates a length-to-width ratio that exceeds 1.618. Consequently, the human brain perceives the dress or the wearer as slim or slender due to this higher ratio.

Illusion due to line effect

This aspect holds significant importance in apparel design, particularly for individuals with excessive or limited height. It operates in the following manner.

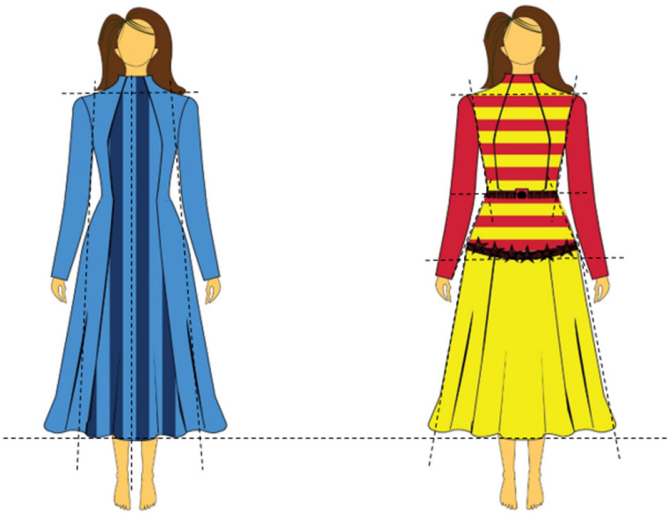

Figure 5: Illusion caused by the presence of lines in the garment.

When considering a vertical line, as depicted in Figure 5 on the left side, the entire body appears divided into vertical rectangles. Each of these rectangles has a greater length but a narrower width, resulting in a length-to-width ratio higher than the golden ratio.

Our brain processes this information and perceives the body as taller and slender. On the other hand, in the case of a horizontal line, shown in Figure 5 on the right side, the body appears divided into horizontally split trapeziums, each with a relatively shorter length compared to the left side, but with the same width. Consequently, the length-to-width ratio of each trapezium is lower than the golden ratio. As a result, the human brain perceives the body as wider and shorter, consistent with the previously discussed length-to-width ratio illusions.

Illusion due to contrast

The color wheel contains complementary and contrasting colors that can create optical illusions. When someone wears a top and bottom garment with high contrast, where the colors oppose each other, it can create the illusion of the body appearing in two horizontally split parts, similar to the left side of the body in Figure 6. Our eyes perceive the two complementary wavelengths of the contrasting colors, leading to a strong difference between them. This difference creates two horizontally split trapezium shapes, similar to the horizontal line effect described earlier. As a result, the brain calculates the length-to-width ratio of these two contrasting trapeziums and may perceive it as equal to or smaller than the golden ratio. This can make the person appear unchanged or shorter and wider, giving the impression of a different body shape.

In contrast, the body on the right side in Figure 6 demonstrates the use of a single color, which creates a vertical effect with a length-to-width ratio higher than the standard golden ratio. As a result, the woman appears slimmer and taller. Consequently, individuals who are shorter can opt to wear one solid color for both the top and bottom to create the illusion of height, while taller individuals can employ significant contrast between the top and bottom garments, leveraging the illusion illustrated by the golden ratio.

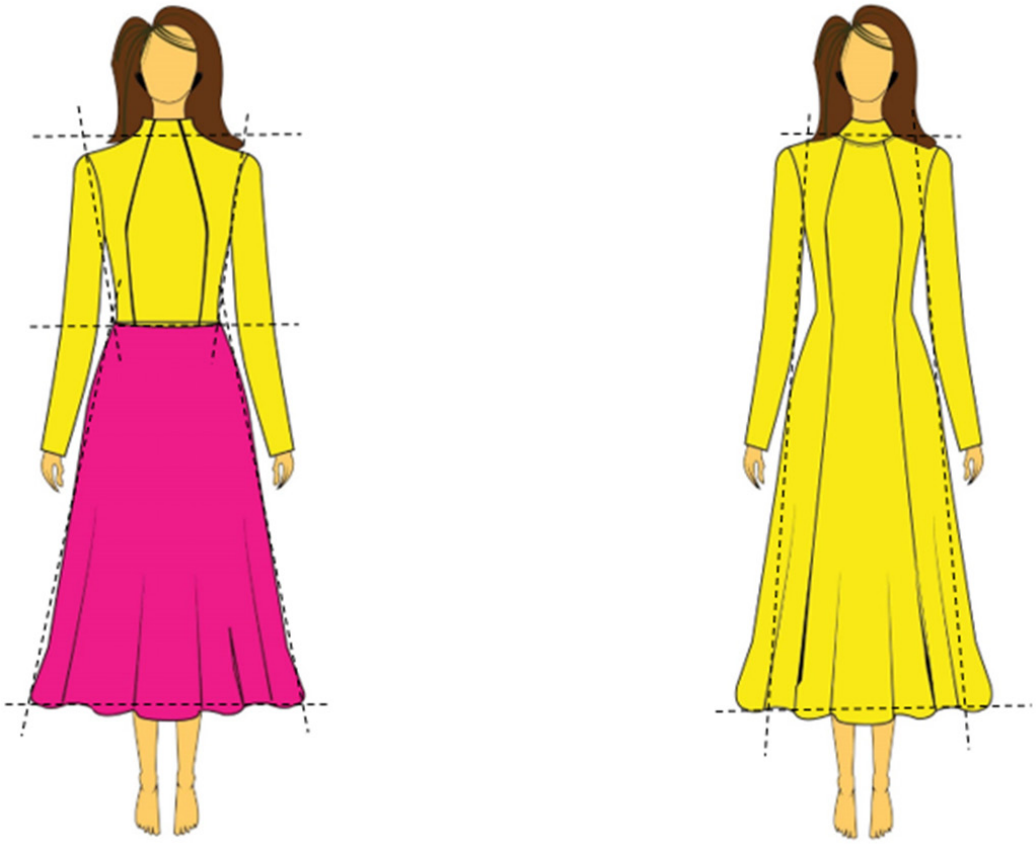

Figure 6: Illusion due to color contrast.

Illusion is not illusion indeed

Sight is another interaction between the human brain and color. The responsible part of the human brain to observe illusion has been discussed before. Therefore, we can state that the illusion or other sights happen through a physiological stimulation in the following way: As both functions f (1) and f (2) follow the full pathway of two "cause and effect", therefore both are real, in reality, there is nothing called illusion. Each illusion is true to the respective observer. The wearer does not seem to be shorter, taller, skinny, or fat rather they are truly shorter, taller skinny, or fat (Figure 7).

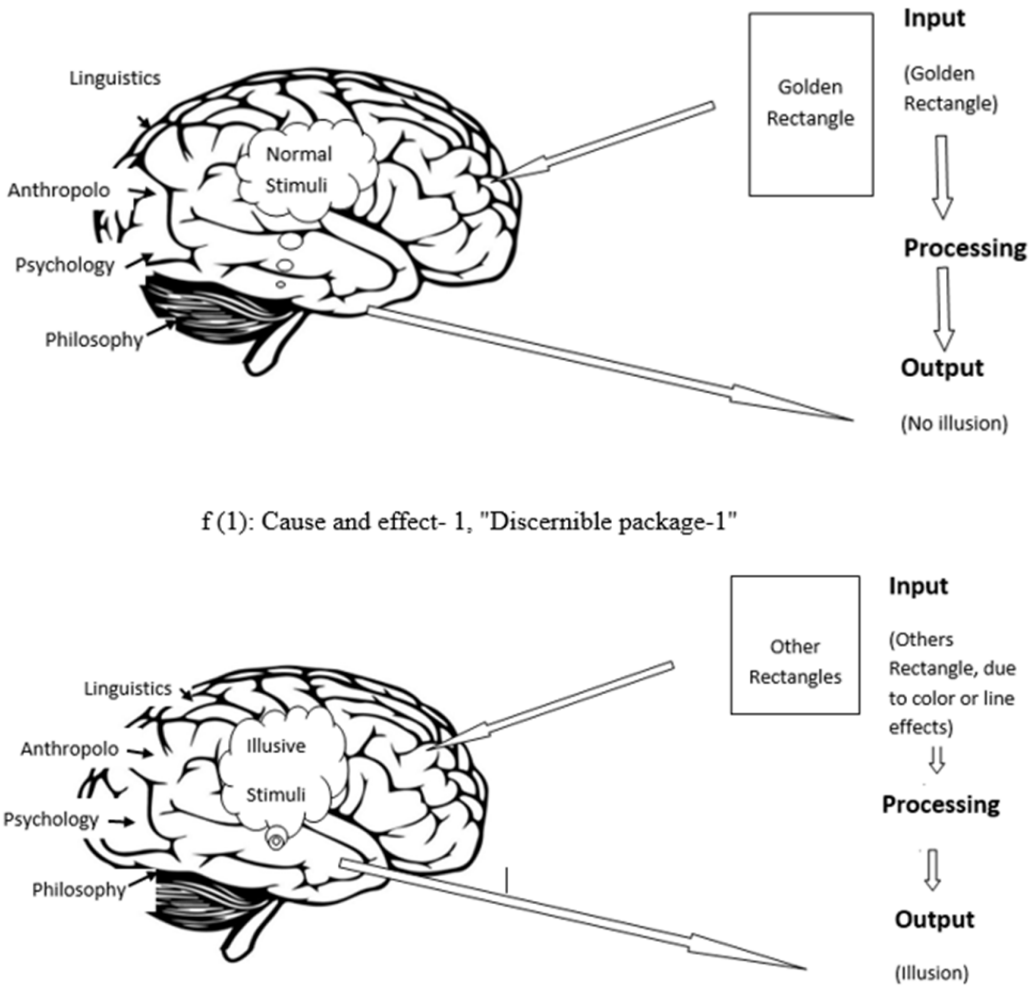

Figure 7: Cognitive Process of an Illusion.

Conclusion

The concept of design emerges from a cognitive process that benefits from standard rules to facilitate its implementation. In contemporary times, a convergence of cultures can be observed between high fashion, mass fashion, and even art (Kim & Ha, 2010), yet all adhere to a standard norm such as the golden mean. Since outfits and designs play a crucial role in attracting attention at first sight, it is imperative to delve into the realm of design, which this study aims to accomplish. Many individuals place great importance on finding garments that fit well and suit their body size, shape, and color preferences. The process of selecting suitable attire can sometimes be perplexing, but this predicament can be resolved by understanding one's body characteristics and the illusions created by the golden number. Disseminating information about design and garment suitability to consumers and sellers through reliable studies can meet their expectations and fulfill their demands. The principal objective of this study is to discover clothing choices that are especially well-suited for individuals who do not have the ideal body size or shape. By exploring different optical illusions, it aims to address the physical imbalances of these individuals, enabling them to feel satisfied and project self-assurance in their interactions with others.

Ultimately, this study reveals the relationship between fashion, the human brain, and their interplay in the context of neuroscience, specifically exploring how they intersect with the physical aspects of fashion. This novel initiative in the field of design prompts further research on this platform particularly through brain scanning procedure during illusion. In this study, recognizing that physics and matter underlie everything in the universe, it becomes highly conducive to explore the physical entity of fashion through the lens of neuroscience, thereby satisfying our desired expectations. While separate research has been conducted on neuroscience and design in the past, this study establishes a relationship between the two. Consequently, from a physiological perspective, we can ultimately conclude that fashion truly "matters."

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