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Perceptions of Blackness: An Interdisciplinary Approach to Science, Culture, and Literature in Iran

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ABSTRACT

The cultural perspective plays a pivotal role in the commercial and industrial success of products, with the color selection process, particularly the choice of black, having a profound emotional impact on consumers. The human visual system distinguishes colors into chromatic and achromatic categories, with black being a significant achromatic color that holds considerable commercial value across various industries, including textiles, printing, automotive, paints, ink, and cosmetics. To maintain quality control, industries require a reliable index to measure blackness. However, the development of such an index is complicated by the subjective nature of color perception, which is influenced by an observer's emotional feelings, cultural and scientific background. This paper delves into the perception and preference of blackness among Iranians, considering their literature, culture, religion, emotions, and scientific viewpoints. The results of this study showed that blackness is not a monolithic concept but is perceived through a spectrum of opposing aspects. Historically, Iranians have associated black with a range of contradictory meanings. In everyday life and popular culture, black commonly symbolizes mourning and sorrow and is used in religious and formal ceremonies. Yet, in the realms of art, literature, mythology, and religion, blackness is interpreted in dual, contrasting ways. These varied interpretations present a significant challenge to the objective assessment of blackness. In fact, developing an index to assess the perceived blackness that gains universal acceptance from color associations appears to be a complex task. This suggests that cultural semiotic structures may act as cognitive priors influencing perceptual evaluation of blackness. Prog Color Colorants Coat. 20 (2027), 237-249© Institute for Color Science and Technology.

1. Introduction

Color evokes feelings, thinking, lifestyle, and culture of a society and closely relates to all the factors and details of people's life. Color is one of the most important visual elements regarding the emotional load that affects the human mind and creates a specific reaction in the soul. In the same proportion that colors can cause attractiveness and a sense of freshness and energy, they can cause fatigue, increase tension, and negatively affect the environment. Since ancient times, colors have been a factor in expressing the identity of peoples and nations and reflecting their wishes and opinions in the form of culture and art. In popular culture, colors play different roles in any era,

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influenced by beliefs and social systems. Colors can be studied and analyzed from different points of view; knowledge, approaches, concepts, and with different goals. Logically, investigating the colors from different aspects depends on their visual perception.

The human visual system perceives the color world based on two groups of objects; chromatics and achromatic samples, normally. From the viewpoint of some color scientists all the colorful objects; i.e., greens, reds, blues, yellows, oranges, and so on belong to the chromatic group while the blacks, whites, and grays are defined as achromatic objects called neutrals, too. The ideal achromatic objects just differ in their lightness (L*) attribute and have no hue and chroma (C*) [1, 2]. While, in the real world, the real achromatic objects with different lightness values benefit from very low tint effects and chroma attribute. Regarding the very small tint effect observed in real achromatic objects, they are defined based on their hue attributes; reddish white, bluish gray, yellowish black, and so on. Consequently, real neutral objects exhibit very low chroma attributes. Generally, the achromatic objects are determined based on their lightness attribute where samples with very low and very high L* values are defined as blacks and whites, respectively. Those achromatic objects that have very low chroma and identifiable hue attributes with middle degrees of lightness are defined as greys [1-3].

The ideal blacks have no chroma and lightness (C*=0, L*=0) while the real blacks are a group of samples with small values of chroma (purity) and lightness properties [1, 3]. It means that the varieties of black objects are perceptible based on their lightness property and tint effects; bluish, reddish, yellowish, and greenish black [2]. The use of this color in various industries such as textiles, plastics, printing, paints, cosmetics, automotive, inks, and so on is of great commercial importance [4-9]. For example, the preference for using black color in printing texts on paper and other surfaces is undeniable and it does not seem that any color can compete with black and replace it [10].

Black as one of the most applicable achromatic objects has its philosophy and concept in various cultures and societies. Regarding the high commercial importance of black objects in various industries, the necessity of presenting an index to evaluate blackness is evidenced. Some researchers investigated the spectral [5, 6, 11-13] and colorimetric behaviors [9, 14-18] of blacks in different industries; textiles, papers, printing, and automotive [4, 8]. A few scientists presented indices to assess the blackness perception [9, 10, 16]. And, one or two studies investigated the cultural concepts of black in some countries [11, 19]. The degree of successfulness of an index to quality control an object's appearance refers to the correlation between the results of that formula and the outcomes of visual assessment experiments. The higher confirmation between an index and observers' visual evaluation, the better formula will be introduced. It means that the color perception of observers should be considered as the final criterion. On the other hand, there are many factors affecting the observer's blackness perception; nationality, gender, and age [9, 16-18]. The nationality of judges is affected by their educational and cultural background. The people who assess and judge the black appearances are inspired by their traditional training, firstly. Reasonably, providing an index to successfully assess black objects depends on knowing and understanding the cultural concepts and definitions applied in various societies [11].

The current research aims to study the blackness perception in Iran from the literature, culture, religion, and scientific point of view. In this way, the researchers that scientifically dealt with the issue of blackness and its evaluation in different fields are referred and then, the concept and application of blackness in the Iranian heritage will be investigated.

2. Methodology

This study adopts a qualitative interdisciplinary approach to investigate the perception of blackness in Iran. The research is structured in two complementary parts. First, the scientific concept of blackness is examined based on established studies in colorimetry, focusing on measurable attributes such as lightness, chroma, hue, and spectral behavior. These findings provide the scientific foundation for the present study; however, as perception ultimately depends on human observers, it is necessary to consider the cultural and literary contexts that shape the interpretation of blackness.

Subsequently, the cultural and literary dimensions of blackness are explored using selected authoritative sources, including classical Persian literature, historical and religious writings, and well-established dictionaries. These sources were selected based on their recognized role in shaping Iranian cultural and

educational frameworks.

The cultural analysis follows an interpretative hermeneutic approach, with elements of semiotic analysis, focusing on identifying symbolic meanings, emotional associations, and contextual uses of blackness across different domains. Finally, these cultural findings are examined in relation to scientific studies on blackness perception to establish a link between measurable color properties and culturally influenced visual judgments.

3. Black in color science

From a physical point of view, an object is called black when it absorbs all or a very high percentage of the radiated light. The reflectance behaviors of objects over the visible wavelengths illustrate those unlike other hues; blue, green, red, yellow, etc., a black object reflects nothing or only a very small proportion of the incident rays [3]. In other words, blackness and darkness are indications of lack or non-existence of enough light. In color science, according to an experimental definition black is one of the two extreme colors existing at the end pole of achromatic surfaces, which is of the least lightness and chroma. In fact, the only difference between black and white is in their degree of darkness [20, 21]. Contrary to white samples, black specimens have received limited scientific investigation from both colorimetric and spectral perspectives. While the chromaticity boundaries of white samples have been well-defined in most color spaces-for instance, in the Munsell system where white and near-white samples are categorized based on value and purity parameters [1, 22], and whiteness formulas incorporate dominant wavelength information [23]-no comparable systematic studies have been reported for black objects. Given that in most uniform color spaces black and white are positioned at opposite poles, it is reasonable to suggest that methodologies developed for whiteness assessment might be adaptable for blackness evaluation [10].

4. Blackness studies

4.1. Scientific analysis of black

Although the chromaticity coordinates and boundaries of black objects as well as the number of black and near-black samples have not been scientifically and systematically investigated, according to the needs of industries and consumers to quality control their products, it seems necessary to conduct research in this regard [11]. Similar to whiteness, blackness perception is a psychological phenomenon and the possibility of comparing such concepts is not easily possible. Reasonably, the need to provide an index to evaluate the blackness perception is very important. As mentioned before, it is impossible to achieve an index to assess the blacks without considering the philosophical and cultural background of blackness perception and preference along with the colorimetric specifications and spectral behavior of a large collection of black samples. Reasonably, this part of current paper considers the studies carried out to scientifically investigate the blackness perception and assessments.

The first studies considered black textile materials to determine the pure blackness, present a novel evaluating method, and explore image features for describing the visual impression of black fabrics. The results demonstrated that reflectance spectra of black fabrics alone could not adequately describe observers' visual perception. Additionally, by investigating the mechanical attributes of fabrics; texture, fiber and yarn, and density, they showed that except for the thickness attribute other physical characteristics of fabrics do not affect the visual perception of blackness. Meanwhile, it was found that while the lightness attribute is used to evaluate the blackness, various black fabrics with the same lightness and different textures and fibers create various judgments of observers, emotionally [14, 24, 25].

The next study refers to blackness assessment in the print industry. Westland et al., focused on determining the optimal black to apply it as ink-jet printers' ink. They mainly aimed to introduce an index to assess blackness. In this way, 100 black papers printed by different inks with various formulations were visually assessed and instrumentally measured. For the first time, four blackness indices were presented based on the colorimetric characteristics of the samples and the applied light source. Then, using the optimization method the weights of colorimetric parameters were assigned. Finally, based on the visual assessment results, that equation showed the highest efficiency and performance was introduced as a metric to evaluate the printed black objects over the CIELAB color order system [10].

The next studies on colorimetric attributes that affect the perceived blackness refer to Clonts and her colleagues. Focusing on the hue preference of

observers, they investigated the blackness perception of three groups of samples; Munsell black papers, wool, and acrylic black fabrics. They investigated the effect of hue on the blackness perception of Munsell samples and acrylic black fabrics, and the effect of chroma and lightness on the perceived blackness of woolen fabrics. Based on the type of applied black samples, the nationality of observers, and the achieved correlation between the results of proposed mathematic models and observers' assessments they provided three equations to describe the blackness perception of observers [15, 16].

In one Equation they ranked the perceived blackness of samples based on the hue attribute (h^o) while; the smaller ranks mean the higher perceived blackness. They showed Munsell glossy black papers with lower chroma values were perceived as more nearly black. Besides, observers preferred blacks with green, cyan, blue, and bluish-purple tints [16].

For the black fabrics, they asked observers to compare the black samples with the reference ones. They showed that samples with hue angles (h^o) between 200^o to 270^o are assessed as blacks. Finally, they presented two statistical models to show the percentage of people who evaluate samples as black. [15].

As a summary, the mentioned studies showed that the cyanish-bluish black samples were evaluated as the blackest samples. Besides, for the blacks with other tint effects, there was a reverse relation between the perceived blackness and the chroma attribute. The achieved results are highly valuable for researchers who aim to present an index to assess the blackness perception [15, 16].

Tao et al. studied the effect of hue, chroma, and value on perceived blackness. Using Munsell samples and two groups of observers; Chinese and English, they examined the blackness perception and blackness preference concepts. In this study, 'blackness perception' refers to whether an observer identifies a sample as black, while 'blackness preference' indicates which black sample an observer finds most aesthetically pleasing among multiple black samples. Their findings indicated that observers evaluated the most neutral and darkest samples as closest to pure black. However, for blackness preference, samples with bluish tint effects were selected, while those with yellowish tints were consistently not preferred. Meanwhile, based on the achieved correlation coefficients they showed that contrary to the blackness perception, the nationality and gender of observers affect the blackness preference [17, 18].

Simultaneously, Jafari and her colleagues analyzed the spectral behaviors of black papers and fabrics for the first time. They showed that various spectral domains; R, 1/R and K/S spaces of black objects could be described in 1, 2 and maximum 3-dimensional sub-spaces. For example, the printed black papers could be explained around one dimension, satisfactorily. Besides, the dyed and printed black fabrics showed that the 2 to 3 dimensional sub-spaces are enough to describe them. The mentioned research proves that depending on the type of black samples and the used spectral domains, from minimum 1 to maximum 3-dimensional space can suitably describe the spectral domain of a black object [13].

Later, Jafari et al., tried to determine the blackness borders based on the volume occupied by black objects in a three-dimensional CIELAB sub-space. They prepared black fabrics with different tint attributes, lightness (from 17.64 to 23.94) and chroma values (from 0 to 4.16). Samples were randomly presented to observers under the VeriVide light booth with D65 standard light source simulator and CIE1964 standard observer. Then, the percentage of samples which perceived as black was determined as PBP (Percentage of Perceived Blackness). The results showed that samples with high lightness and low chroma values, as well as those with high chroma and low lightness attributes, will be accepted as blacks if located in the third quarter of the hue area (the cyanish-bluish blacks). Besides, there was no cyanish-bluish black fabric with PBP=0 %. It means that at least 10 % of observers perceived the cyanish-bluish black samples as blacks while they had a high lightness and chroma values [26]. In addition to the confirmation of the previous studies [15-18] the outcomes of the mentioned research [26] prove the importance of hue preference in the blackness perception of Iranian people.

The effect of lightness attribute on the perceived blackness of Iranian people was studied, too. Observers were asked to rank printed black fabrics in two steps; different groups of blacks with the same lightness attribute and different blacks with various lightness properties. The statistical results of visual assessment experiments showed that the majority of observers preferred cyanish-bluish black fabrics while there were some neutral black samples. Additionally, observers did

not prefer blacks with low lightness and high chroma values and/or reddish-yellowish blacks with higher lightness and chroma attributes [7]. In addition to confirmation of the results achieved by previous researchers [15-18], Jafari et al., proved that lightness is not the only colorimetric attribute that emotionally impacts the blackness preference of Iranian observers [7].

Later, Jafari and Amirshahi compared the spectral reconstruction of black and white fabrics using statistical colorants. To this aim, using the principal component analyzing technique, they compressed the reflectance domain of 457 printed and dyed black fabrics and the total radiance factors (TRFs) of 84 fluorescent whitening agents treated whites. The reduced data were then reconstructed, and the spectral errors were computed based on the averages of the percentile relative root mean square errors between the measured and the reconstructed spaces. They also computed the colorimetric errors between the measured and the compressed-reconstructed dataset using the mean values of the ΔE00 color difference formula. The results showed that the TRFs of whites are smoother than the reflectance space of blacks. Besides, whites could be adequately defined in a 2-dimensional space, while blacks need to be described in spectral spaces with higher dimensions; 3 to 4 [5].

On the other hand, Jafari et al., tried to present an index to instrumentally evaluate perceived blackness. They used black coated fabrics and asked observers to visually rank them based on their hue preference. To investigate the effect of colorimetric attributes; hue, lightness, and chroma on blackness preference of observers, two visual assessment techniques, i.e., the rank-ordering and pair comparison methods, were serially used. According to the results, the lightness of samples affects their blackness preference, although this parameter does not individually impact the outcomes. Besides, regardless of the influence of chroma attribute, observers prefer the black fabrics with a cyanish- bluish tint effect. Additionally, for the black fabrics with very near hue and chroma values, lightness plays a vital role in their blackness perception. Where the lower lightness attribute leads to higher blackness preference of samples [9].

Clearly, the black appearance plays a vital role in automotive industries. According to the research, the most preferred colors for automotive appearances are black and white [8]. Regarding the high commercial importance of blacks in one of the biggest industries all around the world, it was valuable to investigate the blackness perception in the automotive industry. Jafari et al. examined the perceived blackness of metallic automotive panels under three different illumination conditions; i.e., unidirectional illumination, diffuse illumination, and light booth condition. To minimize the influence of total appearance factors on perceived blackness, the black panels have been selected with approximately the same appearance attributes; i.e., specular gloss, distinctness of image (DOI), and orange peel (OP). Results showed that there is a good correlation between the lightness attribute of metallic black finishes and their assigned visual scales under the diffuse illumination condition, where the lower lightness value means the higher perceived blackness. Besides, it was found that the darkest and the most neutral black panel was perceived as the blackest sample under the three examined illuminations [8].

In the other research, Jafari and Ameri investigated the perceived blackness of 10 ACT black panels while they benefit from different levels of orange peel (OP) attribute. Using the pair comparison method, thirty non-expert observers ranked the applied specific automotive finishes from minimum perceived blackness to maximum one under the diffuse illumination condition. According to the results, the perceived blackness of ACT panels increased while their OP attribute decreased. Besides, despite very close colorimetric attributes, the darkest black panel with the lowest chroma attribute was selected as the blackest sample among all ACT black panels and benefited from the lowest OP property [4].

Later the reconstruction of the spectral domain of a series of black fabrics was investigated using the application of the non-negative matrix factorization (NNMF) method. In this study, it was examined if there are some optimal feasible vectors able to match the reflectance spectra of black coated fabrics. To this aim, the NNMF technique was employed to extract the non-negative basis functions from the spectral domain of black fabrics. Next, the extracted non-negative vectors were employed to spectrally match the black samples in one to three dimensional spaces. According to the results increasing the number of optimal primaries leads to decreasing both the spectral and colorimetric reconstruction errors. Besides, using 3 non-negative feasible vectors could mimic the reflectance domain of 363 black fabrics finely.

Meanwhile, it was found that applying chromatic vectors in two and three primary systems plays a vital role in matching the tint attribute of black samples [6].

The mentioned studies analyzed the spectral and colorimetric behaviors of black samples used in various industries to investigate blackness perception and preference. Certainly, the concept of blackness has been interpreted with different meanings in different ethnic cultures. For example, the application of black as an official dress in religious ceremonies in some countries including Middle Eastern societies refers to a strong traditional education [25]. These cultural backgrounds affect the blackness assessments of observers. Reasonably, it is essential to study the traditional concepts of blackness in various societies. The next part of the current paper deals with the research that considered the cultural studies of blackness.

The reviewed scientific studies demonstrate that blackness perception is influenced by measurable colorimetric attributes such as lightness, chroma, and hue. However, these parameters alone cannot fully explain observers' judgments.

From a psychological perspective, black is associated with a wide spectrum of emotional responses. On one hand, it represents power, elegance, authority, and sophistication; on the other hand, it conveys mourning, fear, depression, and mystery. This duality directly influences human perception and decision-making, particularly in visual evaluation contexts, as observers may interpret identical black surfaces differently depending on culturally embedded associations and contextual cues. It means that, these findings indicate that industrial applications of black, mostly in textiles, printing, and automotive finishes, should consider not only instrumental measurements but also culturally influenced visual preferences of consumers. It should be noted that the present study does not employ statistical or experimental methods to quantify this effect; rather, it provides an interpretative analysis based on existing scientific and cultural literature.

Therefore, blackness perception is not solely determined by physical properties, but is also shaped by psychological responses, cultural background, and symbolic meanings. A comprehensive understanding of blackness thus requires integrating scientific measurements with cultural and interpretative perspectives, which are discussed in the following section.

4.2. Cultural studies of black

From a theoretical perspective, color should be understood not merely as a physical phenomenon but also as a cultural sign whose meanings are shaped by historical, religious, and social contexts. Within the framework of color semiotics, blackness is therefore interpreted as a dynamic symbolic construct rather than a purely optical property. Its meanings are continuously produced and transformed through cultural narratives, religious beliefs, and literary traditions. Accordingly, this section adopts a semiotic-hermeneutic perspective to examine the cultural meanings of black and their potential influence on perceptual evaluation. In every culture, people's perception of color is based on the relationships they create between colors and their meaning. There are similarities in the general concepts of each primary color, but some of these concepts appear differently in different cultures. Colors are used to inspire various meanings and symbolize different concepts [27, 28]. From a cultural point of view, there are various interpretations of different colors. Color is used as one of the most significant symbols in the design of the country's flag, which is mainly a reminder of the history of civilization and culture of that country. Also, sometimes in special applications, certain colors are used as a special symbol of a social behavior, support for a certain disease, or to emphasize a special law [11]. Black is not exempt from this. Black and white is more common and especially in the position of symbols and signs, they also contain pristine and special concepts, which are related not only to culture but also to religion and people's beliefs. The contrast between white and black is evident in all ancient and traditional cultures, and it contains opposite emotions, feelings, and phenomena such as good and evil, victory and defeat, good luck and bad luck, life and death, happiness and sadness, friend and enemy.

In the case of dress, black may be considered an expression of depression, despair, discomfort, and mourning. Clearly, the social concepts of mentioned interpretation have always been subject to change and evolution in the course of history.

Black is also the symbol of the darkness of death, the primordial darkness, the non-manifest, the void, shame, despair, destruction, corruption, grief, sadness, humiliation, and renunciation. Additionally, the concepts of time (the color of Cronos/Saturn), hard, pitiless, irrational, and the number 8 are represented

by black. Black or blue-black is defined as the color of chaos, too. Meanwhile, black is related to the mourning and sinister aspect of witchcraft, black magic, and black arts in the Occident. In Alchemy, the absence of color, the first stage of the Great Work, dissolution, fermentation, the sinister, and descent into hell are represented by black. In Buddhism, black is representative of the darkness of bondage. In Chinese culture, black indicates the North, yin, Winter, water, and the Tortoise among the Four Spiritually Endowed Animals. For Christians, black signifies the Prince of Darkness, Hell, death, sorrow, mourning, humiliation, spiritual darkness, despair, corruption, evil arts, and the masses for the dead and Good Friday. In Egypt, black means rebirth and resurrection, and for Hindus, black is the symbol of the tamas, sensual and downward movement, Time, and the dark aspect of the Great Mother; Kali and Durga. For Mayan black means the death of an enemy [29].

The philosophy of these interpretations and different uses of black is related to the cultural, teachings of each society and they transmit certain interpretations and concepts of each color to the next generations. Technically, the cultural roots of the societies are related to their religion, literature, arts, thoughts, education, etc. People educate their children by inspiration from their ethnic cultures. Blacks as one of the most usable achromatic objects in the real world are conceptually learned in the same way. As mentioned before to instrumentally evaluate blacks it is better to know the blackness concept, meaning, definition, and explanation from the viewpoints of people with different cultures and civilizations. These factors affect the observers' blackness perception and preference which determines the key parameters (lightness, chroma, and tint factor) of an assessment formula [11].

In Japan and some Middle Eastern countries, it is mentioned that black is used as the formal dress color in religious ceremonies and formal occasions [11, 14, 24, 25]. Regarding the different colorimetric characteristics of blacks used in textile industries (reddish, yellowish …) Kihara et al. tried to determine the pure blackness of fabrics applied in women's formal dresses. The research topic indicates the importance of black in Japanese culture for formal occasions [25]. Tao and her colleagues presented various meanings of the blackness concept in different countries. They mentioned that black is used in funeral ceremonies in some countries while it has good meaning in Egypt [19].

On the other hand, some researchers examined the effect of observers' nationality on blackness assessments [15-18]. Tao et al., used Chinese and English people to visually evaluate the blackness perception and preference. They showed that while people of various nationalities perceive blacks in the same way, they prefer blacks differently. It means that both Chinese and English presented the same results for blackness perception. They evaluated the most neutral and the darkest samples as the blacks, similarly. While, for the blackness preference the Chinese and English selected different blacks with different colorimetric attributes [17, 18]. Clonts et al., used observers with different nationalities; North American, South American, European, and Asian to assess the black samples. They showed that people with different nationalities assess blacks in different ways [15,16]. Clearly, the nationality of people introduces their culture.

4.2.1. Cultural concepts of blackness in Iran

In the culture and art of Iran in the pre-Islamic and Islamic periods, different beliefs and convictions about colors have been formed. In ancient Iran, dualism was the main source of people's beliefs and religion. This thought influenced all aspects of the art and culture of this period. The concept of darkness and lightness, blackness and whiteness, good and evil arises from Ahura and Ahriman's thinking and their pre-existent and eternal war. Colors have played an important role in this field and have been one of the important characteristics of Iranian historical and artistic works. In the field of art and architecture, the subject and theme of color can be studied and analyzed from the viewpoint of psychology, symbology, cryptology, semiotics, mystical, religious foundations, and philosophy.

To define the blackness concept in Iranian culture it is necessary to refer to the most famous vocabularies are taught and referred in their educational systems, national libraries, and literature; Deh-Khoda, Moein, and Amid's dictionaries [30-32]. The mentioned dictionaries are used as well-known encyclopedias to find the meaning of the words and phrases from cultural and historical points of view. Abundantly clear that the concepts, definitions, and meanings that have been explained in these three references could be

considered as the cultural descriptions of a country to define the atmosphere of the past decades.

According to Amid's vocabulary blackness is usually associated with the color of coal or tar [32]. These three dictionaries introduce black as a symbol of impurity, and ominous happenings from a psychological point of view. For example, in Persian culture, the phrase 'black-hearted' refers to people with indecent thoughts. Also, the phrase sometimes denotes being 'fed up with something'. The concept of 'blackness' is also used to refer to sulkiness, anger, hopelessness, mystery, and secrecy in Iran. Psychologists argue that since black color is physically a combination of all existing colors, it is most suited to describe the mental state of those who are experiencing very complicated thoughts and feelings inside [30-32]. In the literature of color therapy, the use of this color is generally avoided. It is believed that the black color activates the sub-subconscious minds and puts life on the correct path, but overuse of this color induces depression and mental illnesses. Hence its combination with other colors is recommended [11].

4.2.1.1. Black in Persian mythology

Color has a special place in the construction of myths. In fact, color is the key to deciphering many concepts in mythology. In Iranian mythology, the black color is a symbol of superiority, spirituality, and virtue. In the myth of Siyâvash, black is the color that plays an essential role in this Plant Myth with its implicit meaning. "Siyâvash in Pahlavi and Avesta languages means the owner of a black horse or a black-brown horse". The story of Siyâvash and the mourning ceremony of Iranians, when he was killed, was mentioned in Avesta and Shahnameh [33].

In the myth of creation in Persian mythology, the interpretation of whiteness against blackness always means a confrontation between Ahura Mazda; truth, and the Ahriman; devil, and lies. For example, in a hymn dedicated to the Rain God, Tištrya (Tishtrya) is involved in a cosmic struggle against the drought-bringing demon Apaosha. Tishtrya is in the shape of a beautiful white horse with golden ears and golden trappings. Demon Apaosha appears in the shape of a black horse. Finally, this fight ended with Tishtar's victory [34].

According to Dinkard, there are three worlds in Iranian myths. First; the world of "Faraz" or the high sky - where Ahuramazda's seat is and the light is white. Second; there is a "Down" place and below which is the place of Ahriman and blackness. Third; the middle world is golden or red in a different way, which belongs to the people. It is also mentioned in Dinkard and Tansar N'ame that demons (Divan) or Turanians (the enemy of Iranians) come from Abakhtar (North) and have black marks. The Romans, who rushed to Iran from Khor-Veran (West), had red flags and clothes. But the friends of Iranians who come from Khor-Ayan (East) have a white flag in their hands [35].

In ancient cosmological systems, color symbolism was closely associated with celestial bodies, and black was traditionally linked to the planet Saturn and the day Saturday. This association has its roots in Babylonian astronomy and was later adopted by the Mandaean Sabians of Harran, who represented Saturn through black visual elements, such as temples constructed with dark stones and black drapery [36]. Within this symbolic framework, Saturn was often associated with heaviness, limitation, and ominous forces, thereby reinforcing the negative connotations of black as a sign of darkness and misfortune.

This cosmological symbolism appears to have influenced later mythological representations in Iranian culture. In particular, the association of black with destructive and demonic forces can be observed in narratives related to Ahriman, the embodiment of evil in Zoroastrian cosmology. A notable example is the myth of Zahak, the Ahrimani king, from whose shoulders two black serpents emerged-an image that symbolically reinforces the connection between blackness and destructive power [34]. Thus, the transition from astronomical symbolism to mythological imagery reflects a continuity in the cultural meaning of black, where it functions as a signifier of darkness, danger, and malevolent forces across different layers of Iranian intellectual and symbolic traditions. It is noticeable that in Persian myths black is not always a symbol of Ahriman and evil concepts. In the belief of the Iranians in ancient times, the black horse was a blessed and auspicious creature [37]. The king, Vishtaspa's favorite horse was black [34].

From a semiotic perspective, black in Iranian mythology operates as a dual sign, simultaneously representing both negative and positive values. On the one hand, it is associated with Ahriman, darkness, and destructive forces; on the other hand, it represents

power, sacredness, and cosmic order in specific contexts such as royal symbols and mythological figures. This duality reflects a deeper cultural structure in which blackness embodies both negation and transcendence and may influence perceptual ambiguity in blackness evaluation.

4.2.1.2. Black in Iranian religions

Across religious traditions, colors function as important symbolic elements that convey theological, ritual, and cultural meanings. Although no religion possesses an exclusive color identity, particular colors become associated with religious beliefs through specific historical, social, cultural, and geographical contexts. Accordingly, the colors of clothing, ritual coverings, and ceremonial objects perform distinct symbolic functions and are prescribed for different religious practices, social occasions, and spiritual states. The black in Iranian religions, from ancient times until now, has been the color of death, sadness, mystery, and an abominable color with negative psychological effects. The Prophet Mohammad considered black to be abominable except for turbans, shoes, and robes. The black was not permissible for Ihram and shrouds. On the other hand, black was the official slogan of Bani-Abbas Caliphs, and therefore, their official clothes were also black. They wore a pointed hat and a black turban, that's why they were called black-clad men. The workers of al-Abbas also wore black. Women of this period used a hijab that covered the whole body and was usually black [38]. The presence of black in various customs and traditions, in the clothing of Muslim clerics, and Islamic religion and culture, indicates its symbolic and dual meanings. Black covering in mourning and religious flags does not only mean death but also means rebirth and is a manifestation of the spiritual revolution of humans. This revival is achieved in the process of "Destruction and Death". In addition to its association with mourning and solemnity, black in Iranian religious and cultural practices may also carry symbolic meanings related to transformation and renewal. This duality can be observed in traditional figures such as Haji Firouz, whose blackened face is commonly interpreted as a sign of rebirth and the return of life at the end of winter. Rather than representing negativity, this use of black reflects a transitional state between death and regeneration, aligning with broader cultural interpretations in which darkness signifies a preparatory stage for renewal. This example illustrates that black in Iranian cultural-religious contexts cannot be reduced to a singular negative meaning; instead, it operates within a symbolic system where opposing concepts such as death and rebirth coexist. Wearing black in some tribes has a meaning close to Islamic beliefs about Khizr and wearing green refers to eternity. In Islamic literature and mysticism, black is a sign of excellence as the water of life is obtained in the darkness. The night is the time of "not obvious" and the day is the time of "Obvious" [38]. From an interpretive standpoint, such meanings may influence emotional responses to black, thereby affecting perceptual preferences in real-world contexts such as clothing, rituals, and material culture.

4.2.1.3. Black in Iranian Sufism

Sufis and Islamic philosophers create the link between wisdom and ancient Iranian myths and Islamic mysticism, on the one hand, paves the way for receiving the interactional tradition among the followers of both spectra. In Sufism and the mystic culture of Iran, black has two opposite aspects; positive and negative. In some texts, black is a symbol of darkness and mourning and in others, it is a symbol of piety and virtue. Black is the color of a person whose heart is a treasure of divine secret and these peoples hide their spiritual experience and situation from everyone, mystically.

The Sufis have paid special attention to the color of clothing and its connection with the ascending stages and degrees of the Sufi. From the Sufis's viewpoint, a mystic must wear black clothes at some stage of ascension. In Iran, the Sufi elders were not unanimous on wearing or not wearing black robes and ceremonial dress. In the same context Yahya-Ibn Ahmad Bākharzi in "Ourad-Al-Ahbab va Fosos-Al-Adab" specifies that the first person who represented him in black and woolen clothes was Gabriel, that is apparition to Adam in this color [39]. If an adherent has subdued his appetitive soul, then the gnostic for his appetitive soul mourning wears the black dress or bluish-black because black is the color of the afflicted. If Sufi is in the stage of "presence of manifestation of the beauty" then his clothes should be black, thick, and coarse. Within the framework of Iranian Sufism, the symbolism of black is closely tied to spiritual transformation and the stages of mystical development. Sufi thinkers such as Yahya ibn

Ahmad Bākharzi interpret the use of black garments as an expression of inner states rather than merely external appearance. In this context, wearing black signifies a stage of mourning for the ego (nafs) and the suppression of worldly desires, marking a critical phase in the seeker's spiritual journey. Thus, black is not simply associated with darkness in a negative sense but represents a transitional condition in which the individual moves from material attachment toward spiritual awareness [39].

Black light, which is reflected in the Persian painting in the form of black dresses; is the sign of the last stage of the path and disappearance of the seeker in the existence of God and it refers to his unity with the one absolute essence. In Iranian cultural beliefs, the black is a symbol of non-entity or no-thing. Black, also has another symbolic meaning, it means non-individuation or Divine Essence that is even beyond the realm of existence and becomes black only due to the concentration and intensity of light. In Islamic mysticism, light is connected with color. Colors and colored lights can be accepted as mystical values. Two different and opposite uses of the interpretation of "black light" can be seen in mystical literary texts. Black light means the light of God's essence and the light of Iblis. The fluidity of the meaning of black light confronts us with a wide range of meanings in a longitudinal relationship and vertical hierarchy [40]. The color that some mystics like Najmuddin Kubra called "black light", is like the levels of existence. Between these two extremes of light and darkness the spectrum of colors is located. Mohammad Hossein Nayieeji (834 Ah), says: The Sufi sees God in the form of green, dark blue, red, yellow, and white light, but God manifests as black light [40]. From Shabestarī's point of view and his description in Golšan-e rāz, "black" is the color of the light of Divine Essence, and this black has a lofty position in the realm of mysticism [41]. But the other meaning of the black is the darkness of the demonic black night and a sign of Amara's soul. Najmuddin Kubra and Alaa al-Dawlah Semnani both believe that in the stages of transformation of the soul, there is pure darkness at first, which is a sign of the soul of Amara. "Blackness in the first place is the presence of a veil that is placed against the light of the kingdom of truth [42]. This interpretation is further elaborated in the works of Persian Sufi poets such as Shabestari, whose writings explicitly engage with the metaphysical dimensions of light and darkness. In his work Golshan-e Raz, black is described as the color of the Divine Essence, representing a level of reality that transcends visible light. Within this Sufi framework, darkness is not the absence of illumination but the result of its intensity, rendering it imperceptible to ordinary vision. By situating black within this metaphysical hierarchy, Shabestari's perspective reinforces the idea that blackness signifies ultimate unity and transcendence [41]. This interpretation aligns with broader Sufi doctrines in which sensory perception is limited, and true knowledge emerges through inner illumination.

4.2.1.4. Black in Iranian literature

Black is used in Persian poems with various positive and negative meanings. However, it is unlikely that Persian poets, normally known as being gentle, suffice only to the negative and unpleasant aspects of a term and not think of it in pleasant ways. The language of Persian literature is the language of ambiguity, opacity, and irony and as such abundantly revolves around descriptions of the exceptional beauties of the beloved resorting to the same concept (blackness) that is also associated regularly with negative connotations such as misfortunes, darkness, and sinfulness in the same culture. Interestingly, Persian culture acknowledges the superiority of black color over other colors, something which can be the ultimate goal of research from the perspective of the science of colors [11].

Some Persian poets have used black in the concept of authority, glory, and grandeur. In the poems of poets such as Hafez and Nizami,[1] we can see metaphoric compounds such as black snake, black horse, black lion, and black dragon, which symbolize great power. These symbolic representations also associate black with mystery, majesty, and spiritual depth. More broadly, in Persian literature, the symbolic use of black is both extensive and nuanced, often reflecting aesthetic as well as emotional dimensions [43, 44]. For example, in the poetry of Hafez, black is frequently associated with the beloved's hair, serving as a metaphor for beauty, mystery, and emotional depth

1. Niẓāmī Ganjavī, in the Khamsa, employs the word "black" 153 times. The highest frequency of this term (54 occurrences) appears in Haft Peykar, where it is associated with astronomy and its related system of colors. Within Haft Peykar, the most extensive and varied use of the word "black" can be found in the section entitled "Bahram's Sitting on Saturday in the Black Dome and the Tale Told by the Princess of the First Clime" [44]

[43]. This imagery not only emphasizes physical attractiveness but also conveys a sense of enigma and spiritual longing. Similarly, in the works of Nizami, black imagery is employed to represent power, intensity, and dramatic tension, particularly in epic and romantic narratives [44].

To further illustrate the diverse symbolic meanings associated with blackness in Persian poetry, particularly in the works of Hafez, Table 1 presents a selection of metaphorical compounds containing the word “black”. According to Table 1, black is used in multiple semantic contexts, ranging from beauty and attrac-tiveness to power, danger, sin, and moral negativity. This diversity demonstrates the rich symbolic and emotional complexity of blackness in Persian literary tradition.

These literary usages demonstrate that blackness functions as a dynamic symbolic element, capable of expressing both attraction and fear, intimacy and distance. Such representations suggest that the perception of black in Iranian culture is shaped by repeated exposure to these symbolic associations.

In Ferdowsi's Shahnameh, the color has been mentioned 4197 times, and among these colors, black has been most applied in terms of concept and word. The black concept has been mentioned 668 times in Shahnameh. While, for the 458 times the word “black” has been applied and for the rest of it the blackness has been mentioned by the words such as Ebony, Tar, Qar, Moshk, Raven feather, Dizeh, Shabrang, Shabgoun, etc. Ferdowsi has used 18 types of words to express the black group and has used "black color" twelve times to describe demons and the magicians so that their demonic side can be expressed more clearly. Except for the mentioned cases, black has been attributed to clouds and mountains about 40 times to express strength, solidity, and glory. It has been mentioned more than 50 times to describe the woman’s hair as one of their beauty characteristics. Besides, the black has been applied more than 80 times to describe the night, and close to the same amount to describe objects such as umbrellas, cups, crowns, hats, flags, and royal thrones. Regarding the objects, said it is noticeable that black has been mostly used to describe the objects of Iran's enemies in the Shahnameh. For example, the black flag is used 35 times while 4 of them belong to the Iranian and the rest of them belong to the anti-Iranian (Aniran) forces; especially the Turanian [46]. In Shahnameh, the black sometimes finds a completely positive aspect. Ferdowsi in Shahnameh considered the black to be a sign of royal majesty and royal glory [45]. This issue is especially noticeable in the case of the color of the kings' horses. The famous kings and warriors of the Shahnameh such as Siyâvash, Bijan, Bahram Gur, Khosrow Parviz and Esfandiar all have black horses[1], and blackness in this case is a symbol of royal power and glory. During the transfer of power from the Ashkanian to the Sasanian Empire, Ardeshir, the founder of this dynasty, took the Ardavan's favorite black horse with him, and this event can be considered a manifestation of the transfer of power [46].

Black also is the color of the clothing of characters, which expresses their inner states, such as the black robe of the mourners, or the color of the flags, which are a symbol of Ahura or Ahriman manifestations. Comparing to chromatics, the black and white in spite of their big differences benefited from more attention of poet in the Shahnameh. Many of the psychological characteristics and myths of these achromatic colors, consciously or unconsciously, have been reflected in this epic work [46].

1. Shabdiz, Shabahang, Shabrang, and Siah are the names of these horses, all of which refer to the night and its black color, meaning blackness [45].

Table 1: Metaphorical uses of “black” in Hafez’s poetry across themes of beauty, power, and morality [43].

Expressions of Power and Awe	Associations with Sin and Corruption	Representations of Beauty and Attraction
• Black horse (Rare and noble horse) • Black serpent / viper(too dangerous serpent)	• Black heart • Guilty/Sinful record • BLACK-hearted • Black-faced / disgraced	• Black tresses/Dark hair • Black eyes/Dark eyes • Black mole (beauty spot) • Tawny, Dark-complexioned

5. Conclusion

This study demonstrates that blackness is not a purely physical or colorimetric property, but a multidimensional concept shaped by the interaction of scientific, cultural, psychological, physiological, and literary factors. While color science defines black based on parameters such as lightness, chroma, hue, and spectral behavior, the final perception of blackness is determined by observers whose judgments are influenced by cultural background, emotional associations, and symbolic meanings.

In the Iranian context, black carries a wide range of meanings, from mourning, sorrow, and formality in everyday life to power, spirituality, mystery, and transcendence in literature, mythology, and Sufism. These dual and sometimes contradictory interpretations demonstrate that blackness functions not merely as a fixed visual category, but as a complex cultural sign shaped by historical and symbolic contexts.

Such complexity presents a significant challenge for developing a universal index to evaluate blackness. The reviewed studies suggest that measurable colorimetric parameters alone cannot fully explain perceptual judgments and preferences. In particular, preferences for specific tonal variations of black, such as deep or bluish blacks, may reflect not only physical color properties but also culturally embedded meanings associated with elegance, intensity, and symbolic richness.

The findings further indicate that cultural interpretations of black influence its application in various industries, including textiles, automotive design, printing, and product development. In Iran, the association of black with ritual use, sophistication, and authority affects both aesthetic preference and functional application.

Nevertheless, the present study remains primarily theoretical and interpretive in nature. Therefore, future research should integrate quantitative colorimetric analysis with cultural and psychological factors through empirical investigations of perceptual judgments across different populations. Such an interdisciplinary approach may contribute to the development of more comprehensive and reliable models for blackness evaluation.

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