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Information Reflection Theory Based on Information Theories, Analog Symbolism, and the Generalized Relativity Principle †

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Abstract: Reflection Theory holds that our sensations reflect physical properties, whereas Empiricism believes that sense (data), presentations, and phenomena are the ultimate existence. Lenin adhered to Reflection Theory and criticized Helmholtz's sensory symbolism for affirming the similarity between a sensation and a physical property. By using information and color vision theories, analyzing the ostensive definition with inverted qualia, and extending the relativity principle, this paper affirms the external world's existence independent of personal sensations. Still, it denies the similarity between a sense and a physical property. Then, it improves symbolism to analog symbolism and Reflection Theory to Information Reflection Theory.

Keywords: Reflection Theory; symbolism; philosophical fundamental issues; information theory; color model; inverted qualia; ostensive definition; sensory relativity principle

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1. Introduction

Lenin put forward the famous definition of matter in "*Materialism and Empirio-Criticism*" [1]: "Matter is a philosophical category that marks objective reality. This objective reality is perceived by people through their senses. It exists independent of our senses and is copied, photographed, and reflected by our senses". This definition embodies Reflection Theory about ontology and epistemology. This book also points out the following.

A color sense reflects a kind of chromatic light, and they are similar. When Helmholtz affirms that the color sense comes from the stimulation of chromatic light, he is on the side of materialism. When he confirms that a color sense is only a symbol, and the symbol is arbitrary and completely different from the chromatic light, he slips into Kant's agnosticism.

Although the author agrees with Lenin's materialist standpoint, he believes that modern color vision theories [2,3] (including the decoding model of color vision proposed by the author [4,5]) and information theories [6] (including the semantic information theory proposed by the author [7,8]) support the symbolism. Therefore, the symbolism needs to be improved rather than negated. In addition, the author thinks we should defend the existence of the objective world not according to the definition of matter, but according to the ostensive definition or the ultimate denotation of natural language [9,10].

The discussion on the inverted spectrum [11,12] at the end of the last century in the United States supports a new view of the ostensive definition [9,10]; this definition lets natural language pass through sensations, presentations, and phenomena and point directly to the thing-in-itself. The analysis of the ostensive definition can prove the objectivity of the world. For this reason, the author replaces symbolism with analog symbolism, improves Reflection Theory to Information Reflection Theory, and extends the relativity principle in physics to sensory perception so that we can better defend the objective existence of the world and avoid agnosticism.

2. From the Young-Helmholtz Trichromatic Theory to the Decoding Model

The Young–Helmholtz trichromatic theory [2] affirms that human visual cones receive three primary color signals (red, green, and blue), which the human brain converts into many mental colors. This theory is particularly applicable to computer graphics. Physical and mental colors are completely dissimilar since color vision is three-dimensional, and chromatic light is multi-dimensional. Therefore, Helmholtz proposed sensory symbolism or the semiotic theory of sensation [13].

Unlike the trichromatic theory, Herring's opponent color theory affirms that the human retina produces three pairs of psychological color signals: red–green, blue–yellow, and white–black. This is a better explanation for the negative afterimage phenomenon.

The popular zone model attempts to unify the trichromatic and opponent color theories, affirming that color vision exists in the form of three pigments in the visual cell zone and in the form of opponent pairs as the output of ganglion cells. However, this model is asymmetric and does not facilitate the color conversion between the RGB system and the psychological color system with the coordinates of hue, saturation, and brightness. For this reason, the author proposed the decoding model of color vision 35 years ago [4,5]. This model considers the color vision mechanism as an analog 3–8 decoder. The decoder receives three pigment signals and outputs eight mental color signals. For each color, only three outcomes are not 0, from which the human brain obtains hue, saturation, and brightness.

We can interpret the evolution of the color vision mechanism using the decoding model, as shown in Figure 1.

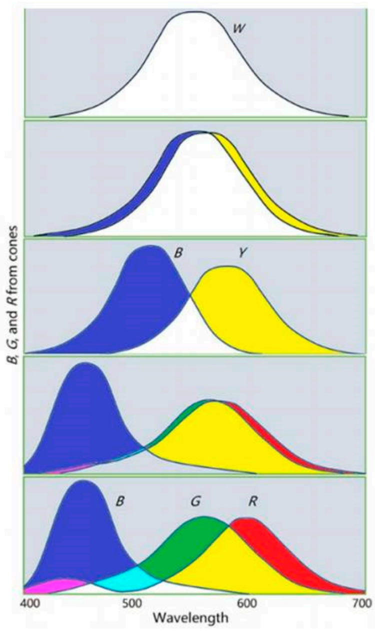

Figure 1. The evolution of color vision is illustrated by splitting sensitivity curves. With the color sensitivity curve splitting from 1 to 2 to 4, the human eye can distinguish between 2, 4, and 8 totally different colors.

The decoding model supports the conclusion that color sensations are analog symbols entirely different from physical properties (different kinds of chromatic light). However, the similarity and difference between two color sensations reflect the similarity and difference between the two types of chromatic light; so, color vision contains information (or semantic information) about chromatic light.

3. How Information Theories Support Symbolism and Analog Symbolism

According to Shannon's information theory [6], for measuring information conveyed by y_j about x_i, the similarity between y_j and x_i is unnecessary. Suppose the prior probability of x is $P(x_i)$, and the posterior probability of x_i after y_j occurs is $P(x_i \mid y_j)$. Then, (the amount of) information is

$$I(x; y_j) = \log \frac{P(x, y_j)}{P(x)P(y_j)}, \quad (1)$$

The average information between y and x (two variables) is

$$I(x; y) = \sum_i \sum_j P(x_i, y_j) \log \frac{P(x_i, y_j)}{P(x_i)P(y_j)}. \quad (2)$$

According to this theory and practice, an image's information can be conveyed by a set of 0–1 codes, even though every pixel is dissimilar to a string of 0–1 codes. Therefore, Shannon's information theory supports Helmholtz's symbolism and opposes agnosticism.

Since Shannon's information theory cannot measure semantic information, which involves truth and falsehood, the author proposed a semantic information formula [7,8]:

$$I(x_i; \theta_j) = \log \frac{P(x_i|\theta_j)}{P(x_i)} = \log \frac{T(\theta_j|x_i)}{T(\theta_j)} \quad (3)$$

where $T(\theta_j \mid x)$ is a truth function, and θ_j is a fuzzy set including all of x that makes y_j true. Assume that there is a typical instance (or Plato's idea) x_j for each y_j and x_j makes y_j true, that is, $T(\theta_j \mid x_j) = 1$. Then, a truth function can also be understood as a similarity function (x_i and x_j are similar).

Although measuring semantic information involves similarity, we only consider the similarity between x_i and x_j, without considering the similarity between y_j and x_i. If y and x are continuous variables, say y for color vision and x for chromatic light, then the similarity between y_j and y_i reflects the similarity between x_j and x_i.

To average $I(x_i; \theta_j)$, we can obtain semantic mutual information:

$$I(X; Y_\theta) = \sum_i \sum_j P(x_i, y_j) \log \frac{T(\theta_j|x_i)}{T(\theta_j)}. \quad (4)$$

This semantic information measure has been applied to machine learning [8,14] and Bayesian conformation [15], and causal confirmation [16]. A new trend is emerging in deep learning. In this trend, researchers use similarity functions and estimated mutual information similar to the above semantic mutual information, achieving vast success [14].

4. How Inverted Qualia and Ostensive Definitions Support Symbolism and Materialism

Locke discovered that if two persons congenitally have two opposite sensations for two colors, such as red and green, as long as they can equally see the difference and similarity between any two kinds of different chromatic light, no one can find that their color sensations are opposite. In 1982, American philosopher Shoemaker [11] published an article, "Inverted Spectrum", to defend functionalism (affirming that the mental state can only be defined by its function) and oppose physicalism (thinking that the mental state can only be defined by its physical state). Since only sense data instead of spectra are inverted, later, most researchers replaced "Inverted Spectrum" with "Inverted Qualia". The commonly accepted conclusions about Inverted Qualia can be found in [12].

As early as 1988, the author [17] introduced in Chinese the debate about the Inverted Spectrum and referred to it as Inverted Color Sensations (ICS). The method to prove the logical probability of ICS [9,10] is to assume that two children naturally have two opposite color sensations for red flowers and green grass. When teaching the two children color names, adults can only point to the red flowers and green grass rather than one's color sensations. Therefore, the children can only unconditionally accept these assignments, despite differences between their color sensations (Figure 2).

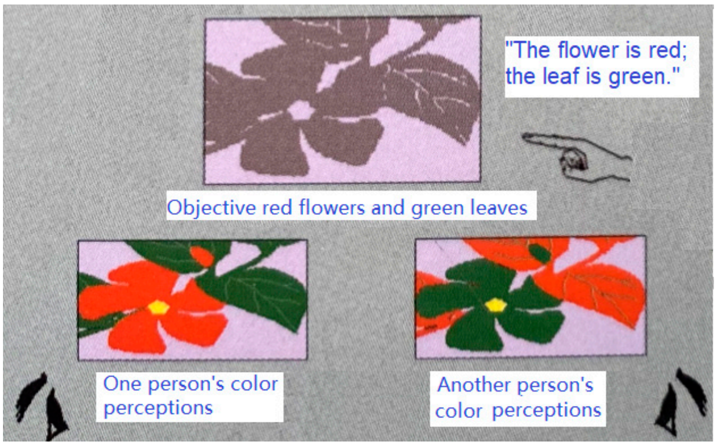

Figure 2. The ostensive definition of "red" and "green" is according to what is pointed to rather than whose color sensations.

Logical Empiricism believes that most words' meanings can be defined by other words, but there are always some words describing physical properties, such as "red" and "green", which can only be defined by the ostensive definition [18]. Using the logical possibility of ICS, the author concludes [9,10] that the ostensive definition is made according to what people point to rather than their psychological sensations; congenitally different sensory organs that can distinguish different colors do not affect the consistency of using natural language. So, natural language goes through sense data, presentations, and phenomena, directly pointing to the thing-in-itself. It is not the external world but others' sensations that are unknowable. This conclusion supports materialism rather than Reflection Theory, which holds that a sensation and a physical property are similar.

5. Sensory Relativity Principle for Further Excluding Agnosticism

In addition to information theories, the relativity principle in physics can also help us exclude agnosticism. This principle (the special relativity principle) says that there is no absolute stationary or standard coordinate system, and all coordinate systems that move uniformly with each other are completely equivalent and indistinguishable. We can consider the sensory organs as coordinate systems and sensations as coordinates to obtain the sensory relativity principle: there are no standard sensory organs, all sensory organs that can equally distinguish physical properties are completely equivalent and indistinguishable (i.e., if people with innately different sensory organs can use natural language consistently, their sensory differences cannot be observed).

The relativity principle of physics does not bring about agnosticism. Similarly, the sensory relativity principle will also not.

6. Conclusions

It is correct that Reflection Theory admits the existence of external objects independent of human sensations, but it is wrong that Reflection Theory holds the similarity between a sensation and a physical property. The reason is that color vision theories, information theories, and the ostensive definition of analysis with inverted qualia support materialism and analog symbolism.

Empiricism, which thinks that sensations, sense data or elements, presentations, or phenomena are the ultimate existence, is wrong because the ostensive definition analysis with inverted qualia reveals that natural language denotes the outer world instead of personal subjective experience.

This paper proposes Information Reflection Theory. It includes analog symbolism and is based on color vision theories (including the decoding model), information theories (including the author's semantic information theory), the sensory relativity principle, and the ostensive definition analysis. It can avoid agnosticism because it is compatible with information theories and the physical relativity principle.

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