

Some thoughts on the philosophy of color

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Some of the main current philosophical theories of color are briefly presented. Based on them and as an analogy, several hypothetical philosophies of heat are offered. Finally, after a discussion and criticism of the hypothetical philosophies of heat, a proposal is offered to deal with the problem of color which solves some of the troubles faced by some current philosophies of color. The limitations of this proposal are also mentioned and discussed

Keywords: Color; philosophy of color; optics.

Algunas de las más importantes y actuales teorías filosóficas del color se presentan brevemente. A partir de ellas y estableciendo una analogía, se presentan varias hipotéticas filosofías del calor. Finalmente después de una discusión y crítica de las hipotéticas filosofías del calor, se presenta una propuesta para tratar el problema del color la cual resuelve algunos de los problemas enfrentados por algunas filosofías del color actuales. Las limitaciones de esta propuesta son mencionadas y discutidas.

Descriptores: Color; filosofía del color; óptica.

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1. Introduction

For almost any scientist, but particularly one specializing in optics such as the author, the reading of many philosophical works dealing with color may be a fascinating experience. It is well known that color has been a complex philosophical problem and no one can deny the importance of color in everyday life. Many human expressions are based on color experience, so its importance is undeniable. However, for some philosophers the problem of color is somehow similar to the problem of time in the sense that it is easy to affirm the existence of time but it is difficult to tell precisely what time is. Particularly after the already classic works on color by C.L. Hardin [1], and A. Byrne and D.R. Hilbert [2], among others [3], there is a deep current interest in the subject among philosophers and scientists alike. There are so many philosophical theories of color that this fact in itself clearly testifies to both the broad interest and also the apparent difficulty of the subject. For some philosophers color is something real and objective, just another property of objects such as shape, mass or volume. For others, color is something more like pain, a personal experience of the subject, and therefore subjective. For others color is a disposition to cause experiences in us. Others hold that color is nothing but an illusion.

In the next section some of the main philosophical theories of color are briefly presented. Later, several hypothetical philosophies of heat are offered. Finally, after a discussion and criticism of the hypothetical philosophies of heat previously presented, a proposal is offered to deal with the problem of color which in the opinion of the author solves some of the troubles faced by some current philosophies of color. The limitations of this proposal are also mentioned and discussed.

2. Philosophies of color

This section presents a summary of some of the most influential current philosophical theories of color. This summary does not claim to be and is by no means complete (*e.g.* some important views such as the ecological one [4] are not dealt with here); however, it does present some of the most important views which are going to be discussed later on in this paper [5].

2.1. Realism

Realism in regard to color essentially states that objects have color in themselves, independently of any subject looking at or being conscious of the object. In a simple way we may say that an objectivist holds that color belongs to objects whereas a subjectivist maintains that color belongs to the subject who perceives the object. The question a realist must try to answer is: Where does the color of an object come from?

The scientific description of the universe is based on terms such as mass, shape, movement and many others. These terms were called by some philosophers, such as Locke, “primary qualities” to distinguish them from “secondary qualities” such as flavor, sound, color and others that were considered non-indispensable in the scientific description of the universe. This means that, for example, in order to provide an account of the movement of a stone in space, only the primary qualities are relevant. The stone will follow a certain trajectory independently of being red or blue, or having cheese or chili flavor. Color and flavor are examples of secondary qualities and were thought non-fundamental in the description of the universe. For some people they could simply not exist.

There are several forms of realism that may be classified as reductive and non-reductive realism.

2.1.1. *Non-reductive realism*

Non-reductive realism or primitivism states that color is an irreducible and basic property of objects. Apparently this position seems to agree with common sense. For a non-reductive realist, color is just another basic property of objects in a similar way as mass or shape and cannot be explained from anything more basic. An objection is that color, therefore does not seem to affect the causal relations of an object with the universe. How could color be a primary property of objects? Clearly this objection is based on the distinction between primary and secondary qualities. For someone who denies this distinction, this is not any objection at all. Another objection is that the color of an object is, from a scientific point of view, explained by the wavelengths that the object reflects; therefore it may be concluded that an object seems to have in itself no color at all. The non-reductive realist may deny that common sense and scientific knowledge are incompatible; she/he may argue that we do not need to take only one as the right position. After all, she/he may argue, the complementarity principle in quantum mechanics is an example of a situation where we do not need to choose between two apparently inconsistent positions. A quantum point-like object may be treated as a wave or as a particle. The non-reductive realist will argue that to accept this is not harder than to accept that in relation to color there is no contradiction between common sense and scientific knowledge.

2.1.2. *Reductive realism*

Common sense shows that objects have color however, the reductive realist will argue, the particles (molecules, atoms, protons, quarks and the like) that make up macroscopic objects do not have color. This is viewed as a problem that the non-reductive realist cannot solve. Therefore the reductive realist will attempt to make non-contradictory the common sense claim that objects have color, with the fact that the constitutive particles that make up the macroscopic objects do not have color. The proposal of the reductive realist is to show that color is the result of a mixture of complex microphysical properties characterizing the objects. These microphysical properties cause some wavelengths to be reflected from objects so they show color. In this way it is shown that color is reduced to some primary properties that do not include color in themselves. In this way, it is argued, any conflict between common sense and scientific knowledge vanishes. An analogy may be taken from the study of gases. All macroscopic properties of an ideal gas such as pressure P , temperature T , volume V , quantity of substance n , and also the general gas law $PV = nKT$, being K the universal gas constant, can be reduced to, or explained from kinetic theory. As will be shown next, a reductive realist may be a physicalist or a dispositionalist.

2.1.2.1. *Physicalism*

The physicalist will try to reduce color to physical properties or so-called primary qualities, that will explain why we see that objects show color. The purpose is to explain color starting from the physical properties of objects and light. Many philosophers see this as a difficult task since very different physical causes may produce a result that our visual system will experience as the same color, for example green entities: trees, grass, sea (some times in some places), emeralds and some parts of the rainbow, among many others. The similarity or even identity of two colors does not imply the same physical structure of the colored entity. So, what is it to provide a reductive physicalist explanation of color? If the color of an object is the consequence of its microscopic characteristics, these are responsible for the specific wavelengths which are detected by the observer. So, one color is the consequence of some microscopic characteristics. A second color is the consequence of some other microscopic characteristics and so on. One problem with this explanation is the phenomenon known as metamerism. This consists in the fact that different combinations of wavelengths may cause identical human color experiences. For example, light made up only of radiation of wavelength $0.577\mu\text{m}$ is perceived as yellow, but light made up in equal parts of $0.54\mu\text{m}$ and $0.67\mu\text{m}$ radiation will also be perceived as yellow and indistinguishable from the first one. A physicalist philosopher argue that: microstructure 1 causes color experience of wavelength λ_1 , microstructure 2 causes color experience of wavelength λ_2 , and so on. However matamerism imply the following disjunction; color experience of wavelength λ_1 , may be produced by microstructure 1 or microstructure 2 or microstructure " n ". Therefore it is not possible to assign a unique microstructure to a color. Even worse, she/he may ask. How many disjunction terms may a color have? Two, three, infinite? If the purpose of reductions was to explain something in more basic terms, the physicalist reductionism philosopher has not succeeded.

2.1.2.2. *Dispositionalism*

Whereas physicalism intends to emphasize what the physical properties of the external world are, dispositionalism emphasizes the experience of the observer. A dispositionalist try to answer what a color is from the fact that color is simultaneously an experience of the subject observer, as well as a property of objects. An object O has a color C only if it seems to be C under standard conditions for normal observers. The object O has the disposition to appear to have color C to normal observers. For a dispositionalist a color is a physical property of an object due to its disposition to cause in observers the experience of color. For a dispositionalist there is no contradiction between the common sense observation that objects have color and the fact that basic elementary particles do not. In this way if color seems to be one for an

observer and another for a second observer, this may be because observation conditions are not normal or because one of the observers has a problem and is not a normal observer. For many philosophers dispositionalism is a good explanation of color even though there are some obvious objections. Perhaps the first one is that dispositionalism seems to be a circular argument. If we ask what is a color C, the answer is that color C is the disposition to look C color. A color is explained making reference to what seems to be this C color. Even though some believe that such circularity is inoffensive, it is clear that dispositionalism does not give much information about what the fundamental nature of color is. Another question is; What is the cause-effect relation of a disposition? For example: Strawberry jam is sweet because of the disposition of jam to taste sweet? For many, trying to explain why something has a color due to its disposition to look that color, does not seem to explain anything, and even less to explain what a color is.

2.2. Subjectivism

Realism was trying to avoid the contradiction between the common sense observation that objects have color and the fact that the elementary particles that made up macroscopic objects do not have color. Realism was trying to keep the truth of both statements. In a simple way, subjectivism will merely affirm that the common sense statement that objects have color is false. After all, they believe, many scientists and philosophers have shown that what common sense affirms is frequently incorrect. Nevertheless, even if we accept that common sense is incorrect, an explanation must be provided of why the world seems to look colored. We cannot deny that humans have color experiences and even if color experiences belong to the subject an explanation is needed. For a subjectivist color is like pain, a personal experience that belongs to the subject, *e.g.* pain may be caused if we are hit by a stone; however the experience of pain is not in the stone but in the subject who experiences the pain. Two important subjective positions on color are mentalism and eliminativism.

2.2.1. Mentalism

Mentalism is any position taking color as a subjective and personal experience. This is a position which may be traced to Descartes. For him there are three substances in the world, *res extensa*, or material substance, *res cogita* or thinking substance and divine substance. For Descartes color, like all secondary qualities, is a sensation which is present only in the spiritual or thinking substance of the being; therefore it does not belong to the material substance of the universe. In a similar way during the twentieth century many philosophers spoke about sense-data as entities which only exist in the mind and are therefore private objects. Mentalist agree that color exists but not in the external objects but only as a private mental sense-datum. Many philosophers have serious objections against the existence of these sense-data, others

prefer to speak about phenomenic properties which depend on the mind and are also subjective.

2.2.2. Eliminativism

Eliminativism states that objects do not have color and the apparent color of objects is due to an internal or mental property. Here color is not explained as the result of sense-data; instead color experiences are reduced to properties or characteristics of our visual system. Color is a human and therefore subjective response from a reality without color. The world is supposed to be achromatic and the characteristics of our visual system are the ones that create the subjective experience of color. Color is a projection of the world created by the subject. Eliminativism does not imply that we cannot speak about color but only makes clear that there is a confusion or fundamental mistake because the world lacks color.

3. Color instrumentalism

To understand the physical world, scientists have developed several theories such as: classical mechanics and general relativity, electromagnetism, quantum mechanics, thermodynamics and statistical physics. Based on these theories we have models to deal with any known aspect of the universe from the cosmological scale to elementary particles. What is the difference between discussing color and any other physical expression of the world such as heat, sound or magnetism? We may wonder why there is not an academic subject called “philosophy of heat”, but there is “philosophy of color”. Why? What is the difference? From the answers to these questions we may obtain some conclusions which may be useful to understand what could also be a philosophy of color theory.

3.1. (Hypothetical) Philosophies of heat

Heat, like sound or color, is a vital and very important experience in every day life, its importance is undeniable. In what follows some hypothetical proposals for philosophies of heat will be presented. This exercise is not idle and will be useful in order to reach some important conclusions latter on that are useful in discussing any philosophy of color. Much of what follows in this Sec. 3.1 may seem ludicrous, ridiculous or both, and the author agrees that it is so indeed. This is deliberate and –in our opinion- necessary as an introduction to the discussion presented in Sec 3.2 and in order to reach our final conclusions.

Someone could put forward a realist theory of heat or a subjective theory of heat. A realist theory of heat would argue that heat is real and belongs to the bodies of the external world. Others would argue that heat is subjective and therefore does not belong to the object but to the subject and essentially is a personal experience of the subject similar to pain. Following the lines of Sec. 2 we could have, very briefly, the following hypothetical results:

3.1.1. *Realist theory of heat*

In a realist theory of heat it is assumed that heat is real and belongs to the bodies of the external world. Objects have heat in themselves. We may have essentially two realist theories, non-reductive and reductive.

3.1.2.1. *Non-reductive*

Realism about heat states that heat is a basic property of objects (something like 18th-19th Century “caloric”). For a non-reductive realist, heat is just another basic property of objects such as mass or shape and cannot be explained from anything more basic. In agreement with common sense it is argued that objects have a property called heat which is independent of any subject perceiving it or being conscious of the object.

3.1.2.2. *Reductive realism*

In this proposal heat is the result of complex microphysical properties which characterize bodies. In this way heat can be reduced to and is the result of primary properties, such as microscopic particle movement. A problem with this proposal is that the perception of heat by humans, the detection of a temperature T, may be different for different people. What is more, since a substance (for example a gas) may be formed by different particles each having different characteristics (different masses and speed distributions), it is normal to have substances with simultaneously two or more different temperatures. However humans when having a heat experience will only state a single temperature for a substance that may indeed have several temperatures. Even worse, almost every person will perceive a different temperature for the same substance. Finally, to complicate things even more, some people may suffer from a temperature inversion problem, feeling hot what is cold or cold what is hot.

It is also hold that this property cannot be explained from any other thing. It would be accepted that heat is a non-reduccionist property of objects. The problem a realist would face is the apparent disagreement between the common sense observation of objects possessing the property of heat and the fact that the basic particles of matter do not seem to have this property. Heat (like color, and flavor) would seem to be a secondary quality of objects. For example, in the description of the movement of a stone in space the stone will follow a certain trajectory independently of whether the stone has a lot or none of this property called heat. Heat, color and flavor would be examples of secondary qualities. That is, properties which in a sense are not fundamental in the description of the universe. It could be argued that they could simply not exist. A dispositionalist theory of heat would follow the following line: an object O has the property of heat H only if it seems to be H under standard conditions for normal observers. For a dispositionalist heat is a physical property of an object due to its disposition to cause in observers the experience of heat.

3.1.2. *Subjective theory of heat*

Realism was trying to avoid the contradiction between the common sense observation that objects have the property we call heat and the assumed fact that the elementary particles that made up macroscopic objects do not have this property. Realism was trying to keep the truth of both statements. In a simple way, subjectivism will merely affirm that the common sense statement that objects have heat is false. For a subjectivist heat is like pain, a personal experience that belongs to the subject.

3.1.3.1 *Mentalism*

Any position taking heat as a subjective and personal experience will be called mentalism. A mentalist agrees that heat exists but not in the external object but as a private mental sense-datum.

3.1.3.2 *Eliminativism*

Eliminativism states that objects do not have heat and the apparent heat of objects is due to an internal or mental property of the subject. Here heat is reduced to the properties or characteristics of our human sensuous system. Heat is a human and therefore subjective response from a reality without heat.

3.2. **From hypothetical philosophies of heat to a philosophy of color**

Why is there not philosophy of heat? Or philosophy of magnetism? Or philosophy of acoustics? Why is there not a philosophical discussion between those who may believe that heat is something real and objective just like any other property of objects such as shape, mass or volume, and those who may believe that heat is something more like pain, a personal experience, or those who believe that heat is a disposition to cause experiences in us, or those who may believe that heat is nothing but an illusion? Perhaps the answer can be found in the fact that we have learned to deal with all heat related questions through the analysis of measurable variables and not through the interpretation of personal experiences. How cold or hot an object seems to be for one person or another is irrelevant to the scientific description of the object. It does not matter how exciting, intriguing or fascinating it may seem to us that an object may be experienced as hot by someone and cold by someone else. The discussion of how heat, sound or color is perceived and interpreted by a human being is a very interesting physiological and psychological question. There is no doubt about it. However physiological, psychological and physical questions should be carefully distinguished. When dealing with heat problems we have the theory of thermodynamics and statistical mechanics. Based on this last theory we can provide a scientific explanation of what heat is, how it can be transformed into a different form of energy, how it is transferred, what the relation is between

heat and all the variables that we can measure from an object, and many other queries.

Could it not be the case that something similar happens in regard to color? The author believes so. Instead of discussing whether color is something real and objective, or a subjective personal experience, or a disposition to cause experiences in us, or nothing but an illusion. Why do we not take the available measurable physical variables of color in order to discuss and understand a scientific explanation of what color is? How electromagnetic radiation can be transformed and interact with matter? What the relation is between color and all the variables that we can measure from an object and an electromagnetic wave? These and many other queries.

We do not speak any more about ether, caloric or phlogiston because they cannot be measured and therefore we conclude that they do not exist. The philosophy of color proposed here is based on what we can measure not through our senses but through scientific instruments. We do not say that an object seems to be hot or cold, we use a thermometer to find its temperature or we carry out experiments in order to measure the speed distribution of its constituent particles. In a similar way, we do not say that an object seems to be blue, green or red, we use a wavelength meter or a spectrometer to find its spectral distribution. In both cases we rely on scientific instruments and our personal perception and experiences are irrelevant. There is no any area of study in physics that will fundamentally rely on our natural senses as detectors. We use and rely on instruments for the detection of movement, acceleration, temperature, electric charge, current, magnetic fields, pressure, etc. There is no reason why color should be an exception. If we stop relying on instrumental measurements when dealing with any area of physics in order to rely on our natural senses, most probably we will go astray.

In a comment to an initial draft of this article Professor Larry Hardin pointed out the following [6]:

There are the physical features on the one hand that are the usual stimuli for sensory qualities, and then there are the sensory qualities themselves. The problem is to understand how or whether these sensory qualities can find a place in a world described exclusively in quantitative terms. In my view, the deep philosophical

issue that underlies the discussion is the classic mind-body problem.

It is also the opinion of the author that the deep philosophical issue that underlies the discussion is the classic mind-body problem. As Professor Hardin pointed out, there are physical features of the world, and sensory qualities. Clearly the proposal presented here does not deal with and in fact avoids the mind-body problem. Instead it concentrates on the physical features of the world as they are measured by instruments. In this way the very subjective world of sensory qualities is also avoided and left to the study of physiology and psychology.

4. Conclusion

What is proposed here is to deal with color problems in the same way we deal with heat, magnetic, sound and any other physical phenomena *i.e.* through the analysis of the readings of scientific instruments. In this paper it is argued that not to do this may lead astray any discussion about color. The above point of view may seem unsatisfactory to many philosophers but the author believes that strictly speaking it is the correct one. The value of a philosophical discussion surely lies in the new ideas which are proposed and which may be experimentally tested. In the Foreword of Ref. 1 Arthur C. Danto sensibly wrote: "No better place can be found for beginning to rethink the limitations on our capability as philosophers than Larry Harding's wise and beautiful book about color. It is not just that he gives us the knowledge we had not thought it necessary to have in order to do philosophy. He demonstrates, irresistibly and irrefutable, how barren philosophical discussion of color is without this knowledge. Philosophical questions about color fall to the ground, as if infected by an unknown virus, as Hardin's deft, elegant, and informed arguments proceed, and the landscape is strewn with dead and dying philosophy by the time the book ends. The virus in question is truth, and its bearer is something philosophers thought themselves immune to, namely science."

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